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SMALL BUSINESS INNOVATION DEVELOPMENT ACT

HEARING

BEFORE THE

SUBCOMMITTEE ON GENERAL OVERSIGHT
AND THE ECONOMY

OF THE

COMMITTEE ON SMALL BUSINESS
HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

FIRST SESSION

WASHINGTON, DC, APRIL 25, 1985

Printed for the use of the Committee on Small Business

U.S. GOVERNMENT PRINTING OFFICE
49-540 O WASHINGTON : 1985

49-540 O—85——1

H721-29

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SMALL BUSINESS INNOVATION DEVELOPMENT ACT

THURSDAY, APRIL 25, 1985

House of Representatives,
Subcommittee on General Oversight
and the Economy,
Committee on Small Business,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:36 a.m., in room 2359-A, Rayburn House Office Building, Hon. Nicholas Mavroules (chairman of the subcommittee) presiding.

OPENING STATEMENT OF CHAIRMAN MAVROULES

Mr. **Mavroules**. The hearing will now come to order, and I do declare the hearing open. I want to welcome you all this morning and appreciate your cooperation in our review today of the important role small business plays in the field of high technology research and development, specifically through their participation in the Small Business Innovation Development Act.

I think all of us here are well aware of the history behind this landmark legislation which awards a share of Government research and development money to fund initial work by small science and technology companies on new ideas and products—ideas that later produce inventions for commercial markets.

Small business is the widely acclaimed leader in innovation and job creation. Studies show that small firms are roughly 2½ times as innovative per employee as large businesses. The SBID Act recognizes that reality.

This is just the type of strong program our country needs to reverse the decline in innovation which is crippling America's productivity and return us to a healthy economy with high employment.

It underlines the message that small businesses must play a major role in technological innovation, which I believe is the key to America's prosperity.

Furthermore, as a member of both this committee and the Armed Services Committee, I recognize the value of small business innovation to our defense industrial base. Small business ingenuity can strengthen and enhance our national security. Let's make no mistake about that.

Yet, up until now, the trouble has been that the small business, despite its status as the most innovative part of the private sector, did not get enough Federal business.

Keeping this in mind, the SBID Program is a particularly appropriate use of Federal funds.

Not only has this provided a new opportunity for small businesses to participate in Federal R&D, but the participating Federal Agencies have also been able to enhance their ability to meet their own research needs. With enlarged pools of scientific and technological experts from which to draw, these agencies stand to upgrade their own technological progress.

Ultimately, the aim is for high-quality scientific and innovative new approaches targeted to meet Agency R&D requirements.

The Small Business Innovation Development Act is a unique program. It clearly offers a major opportunity for small business innovators, but there are several other broad objectives. It enhances technology transfer—converting the research into new products and services. And it encourages commercialization—moving the innovations created in small business labs and workshops into the marketplace, or securing contracts with the Government for equipment and services.

In fact, a couple of firms that wanted to participate in our hearing were unable to do so because they were meeting with larger companies to promote or sell their new developments.

Let me just add a personal note. The strong showing of Massachusetts companies in the highly competitive SBID Program, as evidenced by the two companies we have with us today, is a strong indicator of the importance of small firms in the Commonwealth and in the Nation at large, as a source of new technological development. The money that will flow into Massachusetts through this program, an estimated $250 million, is expected to strengthen the small firms that receive it, helping them to grow in communities all over the State.

I have long felt that to better utilize this innovative industrial source, the Federal Government must make an extra effort to involve American small businessmen and women. It is, therefore, the goal of this subcommittee to continue to review other aspects, the problems and successes, of small business research and development activities through potential Government involvement and opportunities within the commercial marketplace. I hope today will provide us with an excellent starting point.

Finally, I would just like to add that I am pleased the administration has reversed its original proposal to cap at 1 percent the Federal R&D funds available to the SBID Program for fiscal year 1986.

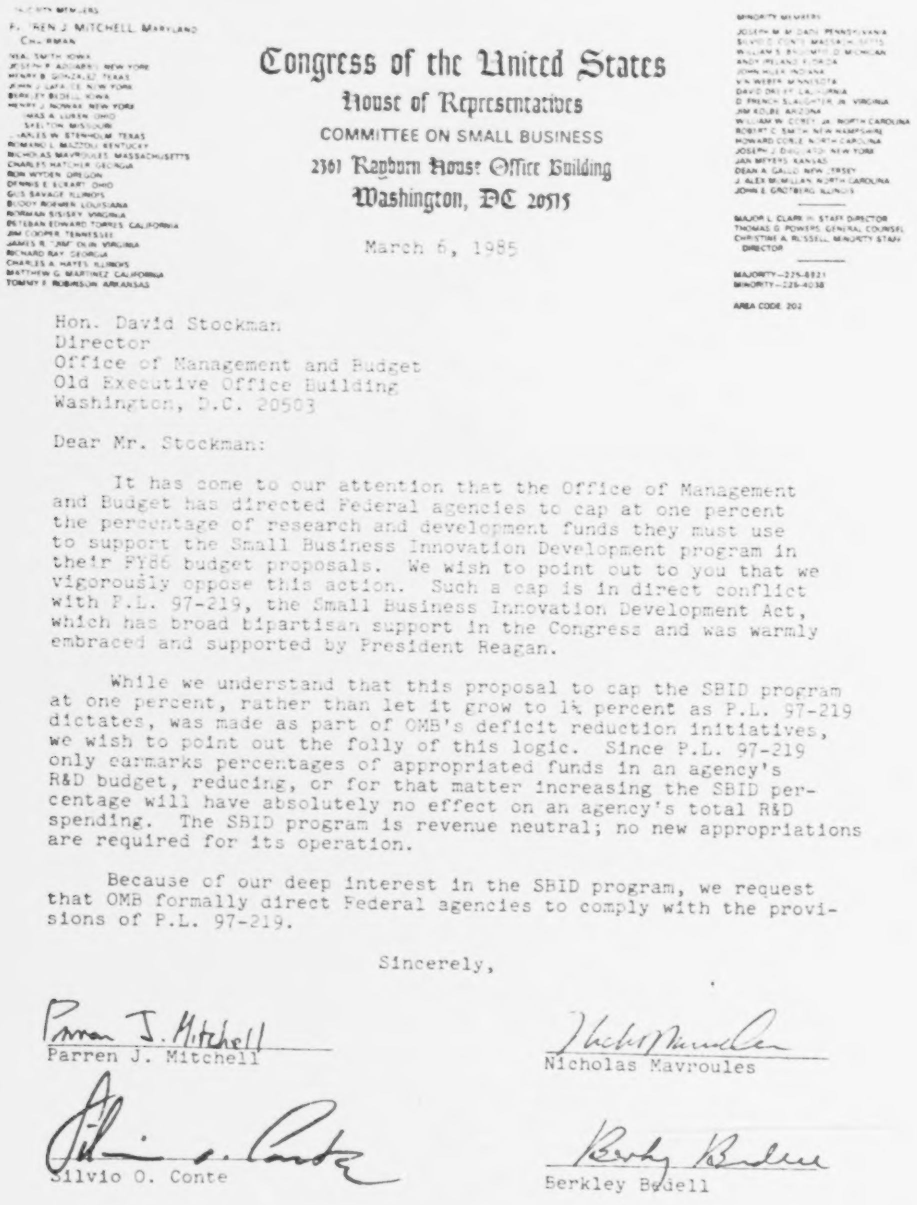
We, on this subcommittee, made it very clear in a letter to OMB Director David Stockman that this action was absolutely unacceptable, and that it did not make any sense as a budget saving method, since the SBID Program is essentially revenue neutral.

In the response we just received from Mr. Stockman, the administration agrees that the percentage of research and development funds set aside for small business should be at 1¼ percent as provided in Public Law 97-219, not capped at 1 percent.

I have enclosed for the record a copy of our letter to the Office of Management and Budget, along with the response from David Stockman.

This action recognizes the value of this program, and I think that today's testimony will also prove that the Small Business Innovation Development Act is an overwhelming success worthy of our continued and active support.

[The attachments referred to above follow:]



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AREA CODE 202

March 6, 1985

Hon. David Stockman
Director
Office of Management and Budget
Old Executive Office Building
Washington, D.C. 20503

Dear Mr. Stockman:

It has come to our attention that the Office of Management and Budget has directed Federal agencies to cap at one percent the percentage of research and development funds they must use to support the Small Business Innovation Development program in their FY86 budget proposals. We wish to point out to you that we vigorously oppose this action. Such a cap is in direct conflict with P.L. 97-219, the Small Business Innovation Development Act, which has broad bipartisan support in the Congress and was warmly embraced and supported by President Reagan.

While we understand that this proposal to cap the SBID program at one percent, rather than let it grow to 1¼ percent as P.L. 97-219 dictates, was made as part of OMB's deficit reduction initiatives, we wish to point out the folly of this logic. Since P.L. 97-219 only earmarks percentages of appropriated funds in an agency's R&D budget, reducing, or for that matter increasing the SBID percentage will have absolutely no effect on an agency's total R&D spending. The SBID program is revenue neutral; no new appropriations are required for its operation.

Because of our deep interest in the SBID program, we request that OMB formally direct Federal agencies to comply with the provisions of P.L. 97-219.

Sincerely,

Parren J. Mitchell
Parren J. Mitchell

Nicholas Mavroules

Silvio O. Conte

Berkley Bedell
Berkley Bedell

Joseph P. Addabbo

J Cooper
Jim Cooper

Joseph J. DioGuardi
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Jim Olin

EXECUTIVE OFFICE OF THE PRESIDENT
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WASHINGTON, D.C. 20503

APR 16 1985

Honorable Nicholas Mavroules
Committee on Small Business
U.S. House of Representatives
Washington, D.C. 20515

Dear Nick:

Thank you for your letter concerning the Small Business Innovation Development program.

As you know, the Administration has proposed to transfer the consideration of small business issues from the Small Business Administration (SBA) to the Administration for Enterprise Development and Opportunity within the Department of Commerce in order to provide a Cabinet-level voice for small business. In addition, the Administration proposed the termination of the credit programs of SBA and the transfer of SBA's remaining loan portfolio to the Treasury for disposition. The Administration remains committed to these proposals, as well as the Small Business Innovation Development program, and we agree that the percentage of research and development funds set aside for small business should be 1 1/4% for 1986, as provided in P.L. 97-219, not capped at 1%. This position is being conveyed to all Federal agencies affected by the program.

Thanks again for sending me your views. I hope this clarifies the Administration's positions and commitment to the elevation of small business issues to the Cabinet level, the termination of SBA, and the percentage of research and development funds set aside for small business.

Sincerely,

Dave

David A. Stockman
Director

IDENTICAL LETTERS SENT TO HONORABLE PARREN MITCHELL,
HONORABLE SILVIO CONTE, HONORABLE BERKLEY BEDELL,
HONORABLE JOSEPH ADDABBO, HONORABLE JIM COOPER,
HONORABLE JOSEPH DIOGUARDI, HONORABLE CHARLES STENHOLM,
HONORABLE IKE SKELTON, HONORABLE CHARLES HATCHER,
HONORABLE NORMAN SISISKY, HONORABLE DAVID DREIER,
HONORABLE NEAL SMITH, HONORABLE JIM KOLBE
HONORABLE JOSEPH MCDADE, HONORABLE TOM LUKEN,
AND HONORABLE JIM OLIN

Mr. MAVROULES. I would now ask my distinguished friend and colleague from Massachusetts, the ranking minority member, Mr. Silvio O. Conte, if he has an opening statement.

OPENING STATEMENT OF HON. SILVIO O. CONTE, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MASSACHUSETTS

Mr. CONTE. Thank you, Chairman Mavroules, for scheduling the hearing today on the Small Business Innovation Development Program. In the 2½-year history of the program, SBID has more than proved its worthiness.

In 1983, $44 million was awarded to small businesses, and in 1984, those awards increased to $100 million. Today's witnesses will testify to the tremendous benefits that the SBID Program provided to their firms.

Government Agencies have also recognized the benefits of the SBID Act. The Education Department's Assistant Secretary said that project activities of very high quality and potential benefit to education have been identified which would have been unlikely candidates for funding in the absence of the SBID provision of the Small Business Innovation Development Act. Mr. Chairman, as a strong supporter of this program, I commend you for holding these hearings today so that the program's beneficiaries can report directly to us on their experiences and successes with the SBID Program. Thank you.

Mr. MAVROULES. Thank you for your statement, Mr. Conte. I would now ask Mr. Olin if he would have an opening remark?

OPENING STATEMENT OF HON. JIM OLIN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF VIRGINIA

Mr. OLIN. Thank you, Mr. Chairman. I would like to thank you for having this hearing. I think it is an excellent idea. I am approaching this hearing with an open mind because this program is relatively young. I think the idea of helping small business engage in major research activities is a highly commendable one.

It is important to make sure we are looking at the results objectively. We want to be certain we have a program which is benefiting research, as well as the companies receiving the funding. It is important to be sure we do not have a program which is merely providing money, but is giving us good, solid research results.

Mr. MAVROULES. Thank you. That is one of the reasons we are having the hearing, and I am sure we are going to hear some very meaningful testimony this morning.

I want to state for the record that the hearing record will remain open for 10 days. I also want to submit for the record written statements that have been sent to me by Mr. Tom Callahan of the University Research Engineers and Associates and also Harvey Brandwein of Genetic Diagnostics Corp.[1] An opening statement by our colleague, Mr. Joseph Addabbo from New York, will be inserted here.

---

[1] See appendixes C and D.

OPENING STATEMENT OF HON. JOSEPH P. ADDABBO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW YORK

I would like to congratulate my colleague Mr. Mavroules as the new chairman of this subcommittee. I would also like to commend the chairman for holding his first hearing on a very important program, the Small Business Innovation and Research Program.

The Small Business Innovation Development Act of 1982 requires Federal agencies with extramural research and development budgets in excess of $100 million, to expend a small percentage of the R&D funds through Small Business Innovation Research Programs. The SBIR Program is in its third full year, and the indications are that the program is succeeding and new firms are participating in federally funded R&D efforts.

The SBIR Program is highly competitive and provides funds for the feasibility testing of innovative ideas with phase I and phase II funding levels of up to $50,000 and $500,000 respectively. In fiscal year 1984, approximately 8,000 phase I proposals were submitted by small firms. Of that amount, 999 firms received awards. Of the 560 phase II proposals received, 338 firms were given awards. The quality of the proposals was high and twice as many proposals were considered to be worthy of funding had sufficient funds been available.

The creation of this bipartisan program was a response to numerous studies which indicated that small business innovation far exceeds technological breakthroughs by large firms and that the cost per innovation is far less. The redirection of a percentage of the Federal R&D budget to these small but efficient and highly innovative firms has proved to be a very effective use of public funds. I am committed to seeing that this vital program survives the fiscal year 1986 budget process.

Mr. Chairman, I look forward to hearing today's testimony.

Mr. MAVROULES. Our first panel this morning will include Ann Eskesen, who is the president of IDI, Innovation Development Institute, and also Mark Levine who is the assistant to the president of Geo-Centers, Inc., a small high-technology company. Mark previously worked for the Small Business Committee where he was the staff director of the Subcommittee on General Oversight and the Economy. I would ask both of you to please come forth and give your opening statements. The first statement will be given by Ann Eskesen.

By the way, I want to thank you very much for your cooperation with the committee in helping us and assisting us with this hearing this morning.

TESTIMONY OF ANN ESKESEN, PRESIDENT, INNOVATION DEVELOPMENT INSTITUTE, SWAMPSCOTT, MA

Ms. ESKESEN. First, Congressman Mavroules and members of the subcommittee, I would like to thank you for the opportunity to testify on this occasion specifically on the progress of the SBID Program.

My name is Ann Eskesen. I am president of Innovation Development Institute, a small firm in Swampscott, MA. I am a member of the board of the Small Business Association of New England, SBANE and one of the people, several of whom are in this room today, who was extensively involved in the passage of the SBID legislation and in its subsequent implementation.

To borrow from the jingle in the commercial, in those intervening 3 years, we've come a long way, Mr. Chairman.

There was, as you know, a prolonged and bitter debate which surrounded passage of the legislation, and fundamentally that debate focused around the concerns that the small business community, who are a demonstrated, innovative part of the research and business community of this country, were either by choice or by circumstance largely excluded from the R&D process at a time when the Federal research dollar was a very important part of that process.

Ironically, that condition applied to a time when the innovative capacity of this Nation was, and still is, being seriously challenged in domestic and international markets, when the availability of funds to support the research effort which initiates the innovation process was in serious and short supply, particularly to the smaller firms.

With the sustained support and efforts of members of this committee and their staffs, the legislation SBID was passed into law and Congress mandated the use of the program which has been so effectively developed through the National Science Foundation in the several years previously.

In my written statement, I have charts identifying the current departments, the level of fundings at the various stages, and so on, but I would like to spend my time today looking at what has happened in that intervening time.

We are now in the third year of the program. The solicitation and submission cycle for fiscal year 1985 is now completed in 9 of the 12 agencies, and in my written testimony I have included a great deal of information, background to who is putting out what in what sort of dollar amounts and what timeframes and so on.

The program objectives were established as twofold. First was to encourage the greater involvement of the small technology based firm in the research efforts of the Federal Government.

The second was to target that support toward development of technology which would specifically find application, that is, to complete the innovation process and to use what we know. Again, for the record, I have inserted an article which I wrote sometime ago called "What is the National Question to Which SBID is an Answer?" which specifically examines that whole problem of not using what we know in technological fields.

Progress toward the first of these objectives was fairly rapid. It was in the first report out of the Small Business Administration that only about 20 percent of the award winners in fiscal year 1983, phase I, had ever had any previous Federal Government experience.

My firm just completed a fairly major study of the SBID usage in the State of Massachusetts, and our findings confirm those of the Small Business Administration in a general sense.

While there were about 47 percent of companies which reported that some of their principals had had Federal experience previously, only 7 percent of those indicated that that experience was of any major consequence. There is also evidence, as yet anecdotal, that in several of the mission agencies, DOD and NASA in particular, that the SBID active firms are establishing the contacts and developing the opportunities that will translate into a more active presence in the regular Federal R&D procurement effort.

These are very early days. Two years of activity and results do not make a trend. Specifically, the time frameworks in which product development and new process development takes place are very long, minimally 7 to 8 years, and in some fields as much as 13 to 15 years. In those time frameworks, we have barely begun.

We have no major technological breakthroughs to report at this time, nor substantial business development as a consequence of SBID involvement. It is not even obvious that at the end of the 6-year period that we will have major numbers of these types of results to be reported. But it is apparent—very much apparent—that progress is being made towards these objectives and the testimony of the several witnesses today will go a long way toward verifying that statement.

A diversity of small firms all over this country are being brought into the program. There is a level of enthusiasm that we find within the small business community, within the general business community, and frankly in these days, also within the agencies for the success of this program; a climate which has been created and established which if allowed to developed is a source for considerable optimism.

Over the 6 years of the program to fiscal year 1988, it is estimated that $1.32 billion will have been distributed by the participating agencies to support about 5,000 phase I feasibility projects and probably as many as 1,350 for continuance into phase II.

I have included for the record all the statistics on the distribution in the various States and from the various agencies. It is interesting to note here that there were 781 phase I awards made in 1983 and 990 made in 1984. Of those projects, 271, not including those most recently announced in the National Science Foundation, are presently in the first year of their phase II effort, with an expected 350 additional phase II awards by the end of this year.

Within the States, I should point out there has been an interesting pattern. The early NSF Program, and the Voluntary Program run in the Department of Defense [DESAT], were dominated by firms in the States of Massachusetts and California who collectively took almost two-thirds of the awards, with comparatively minimal representation in other parts of the country.

That strong participation continues, but firms in those States had better not rest on their laurels, because there are an awful lot of other States which are very active in this program. SBID informational briefings and conferences have been held all over the country, and in several States there is a clear and concerted effort being made to supply the support structure that the SBID companies need properly to use this program as a business development tool.

In Pennsylvania, perhaps you are familiar with the Benjamin Franklin Partnership and SEED Grant Programs. In the State of New York, there is, in fact, a matching grants program under which the SBID award winner at phase I becomes automatically eligible for a matching grant provided by the State of New York if they complete that phase I process and go into phase II application.

That is a very particularly interesting effort, because it addresses directly the problem of the phase I-phase II funding lag which is a characteristic of the program in several agencies and is identified by many firms as a problem to them.

Before addressing the activity level of the States and the issue of retention, because that is an issue that I think is important—we are losing a large number of companies between phase I and phase II, and I think we need to look at that question—we need to look at why the States are so interested in this program. The kitty is not particularly large. It is $250 million this year, $428 million next, and distributed around the 50 States. Individually no State is going to a get a great deal of money.

Nevertheless, what we are finding is a considerable interest, and that interest is primarily for two reasons. First of all, we are finding that there is a credibility enhancement to the companies that comes as a result of their SBID involvement.

In fact, as I note in my written testimony, the earlier program was characterized by an involvement predominantly by the very small firm, less than 10 employees. We are seeing larger small firms involved now though the more fleet-of-foot smaller firms are, in fact, beating them out proportionately.

But, as the larger companies get involved and the smaller companies too, one of the things they identify as being most important to them is the technical credibility that is provided to the firm when they have survived the rigors of the very energetic SBID competitive process.

That process is an extremely competitive one—probably one of the most competitive in the Federal procurement effort. A firm which survives that process can clearly claim, and have evidence to prove, that they are on the technological leading edge in their field. That is a very important factor that is often overlooked but is, in fact, key in whether the companies are going to be able to continue.

From the point of view of the States, however, the money aspect is important. In the National Science Foundation Program, the trend seems to have been toward a leveraging factor of about $7 to $8 for every $1 that the Federal Government provided.

Let's be a bit more conservative and suggest a leveraging factor now of about $5. For every $1 that the Federal Government supplies, a leveraging factor of $5 from private sector resources comes from venture capital, public offerings, involvement by the larger firms, and so on.

For purposes of demonstration, I took those figures and applied them to the condition in Massachusetts. For 1 year, the very first year of this program, the State of Massachusetts, took 142 phase I awards. That was an income flow of about $7 million in phase I awards.

Fifty-two of those awards were translated into phase II. That calculates out to about $18.2 million. If we use my conservative estimate of a 5-to-1 leveraging factor, that means that over $90 million of private sector funding is expected to flow into Massachusetts firms as a direct consequence of SBID involvement for 1 year of awards in that State.

Though less dramatic, those same types of statistics really begin to leverage out in some of the other less actively participant, but rapidly emerging States. When the State of New York can look at the likelihood involvement of $200 to $300 million flowing to their companies, those are figures to grab the attention even of a New Yorker.

Though estimates of the number of small firms expected to qualify to participate in SBID were very high, an estimated 25,000 to 30,000 firms, since passage of the legislation, in fact, approximately

1,000 firms have been involved in the program to the extent of receiving an award.

I have included in my testimony a breakout of the activity level and retention rates in each one of the States.

As you might have expected, California has by far the largest number of firms involved in the program with Massachusetts coming in second, but it is also interesting to note the very active levels of participation in Colorado, Florida, Maryland, New York, Ohio, Pennsylvania, Texas, and Virginia.

It has been our experience that SBID effective usage is not simply a question of racking up the numbers. It is a question of being able to convert that effort into phase II, and subsequently into phase III activity.

The firm which targets its efforts in that direction, as represented by the firms here today, will successfully convert from phase I to phase II. In the first set of phase II awards announced, 274 awards were made to a total of 221 companies; that is, 39 firms took more than one award. Again, I have given, in my written testimony, a by-State breakout of these phase II awards.

In contact with, and study of, the SBID involved firms we found that, depending on the age of the firm, the state of development of the technology, in the industry focus and objectives of the firm, as a resource the awards are being used to support the development of the technology, to strengthen the intellectual property of the firm, to examine and support potential applications of a technology previously developed, and, in the more established firm, to investigate the next generation of products which will support that firm's continued development and operations.

While it is likely that the percentage of SBID firms which go on to significant growth using venture capital will probably be larger among the SBID group than among the general group of technology based firms, it is clearly evident that a relatively small percentage of these firms are looking at serious growth. More commonly, the evidence suggests, that the completion of the innovation process—taking a research idea for a new product or process through all the stages of research, development, demonstration into commercial application—that process will be completed largely by some form of technology transfer or integration effort.

It will be achieved by customized development to a high value-added specialist market, by licensing, joint venture, or subcontracting arrangement.

In conclusion, I would like to comment on the high levels of interest in SBID that are being expressed, among those who are part of that phase III technology transfer effort. A number of developed relationship to the venture community, to large firms and to others with resources required to complete that innovation process are already being formed. There are not many yet, but there clearly is evidence that there are going to be a great deal more.

It is also an interesting comment that if imitation is the most sincere form of flattery and evidence of success, it should be noted that the strong indication of SBID-like programs being considered in other countries, in Britain and the Netherlands, for example, anxious to promote the growth and contribution to the economic health of the Nation of their technology based small business community.

We are aware that pockets of resistance and opposition to SBID conceptually and practically, continue to exist. However, among those who are using this important new program, and understand its use, the assessment is uniformly positive. This program works, allowing the best among this Nation's technically competent to fulfull their long-time role as contributors into the vital innovation process. Thank you.

Mr. **Mavroules**. Thank you very much for your well-thought-out statement, Ann, and at this point I am going to include your prepared statement as part of the record, without objection.

Ms. **Eskesen**. Thank you, sir.

[Ms. Eskesen's prepared statement, with attachments, follows:]

Prepared Statement of Ann Eskesen, President, Innovation Development Institute, Swampscott, MA

First, Congressman Mavroulas and members of the committee, may I thank you for the opportunity to testify on this occasion on achieved progress in the Small Business Innovation Research SBIR program (SBIR)? My name is Ann Eskesen. I am President of the Innovation Development Institute (i d i), a small firm in Swampscott, MA.; a board member of the Smaller Business Association of New England (SBANE) Waltham, MA.; one of the many people, several of whom are here today, who were extensively involved during 1982-3 in passage of P.L. 97-219, the SBIR enabling legislation and, perhaps as critically, since then in the implementation effort.

To borrow from the commercial jingle, in that intervening three years - we've come a long way, Mr Chairman!

In the prolonged, and sometimes bitter debate which surrounded passage of the SBIR legislation, it was argued that, for a number of reasons, over the years the opportunity for qualified small firms to participate in, and contribute to, the federal procurement effort, particularly in the specialist areas of research and development had been deteriorating. Subsequent data prepared for a Report of the President, The State of Small Business, transmitted to Congress in March 1984 (see Tables I, II and III, and Figure 1 in Appendix I) substantiated that assertion. It was determined that, though the dollar amount awarded to small firms had increased in each of the preceding four years, the percentage of the total available funds which flowed into small firms had progressively decreased.

In similar vein, it was apparant that many technically competent small firms, entirely qualified to participate in federal procurement were not doing so - that by choice or by circumstance, they were effectively closed-out of the process. In sum, that that population which several independently conducted studies had demonstrated to be a prolific and cost effective source of innovation through the years, were less and less involved at the federal level.

Ironically, these conditions applied at a time when the innovative capacity of this nation was (and still is) under serious challenge in domestic and in international markets, when federal support of the R&D effort in this country has become progressively more important, and when the availability to small firms of that high risk, early-stage product (process) development support on which subsequent business and economic development is founded was seriously limited.

With the sustained assistance of many on this committee and their staffs, the case was made to address these conditions, to facilitate their access to needed resources and to permit qualified small firms again to contribute their best efforts into the health and vitality of the national economy by requiring all federal agencies with a substantial commitment to support of extramural research to allocate a legislated percentage of that R&D dollar to technically competent small firms.

Congress mandated that the mechanism to be used in this effort in the (now) twelve federal agencies (see Table IV below) was that developed to meet a similarly defined objective in the National Science Foundation (NSF) - the three-tiered structure of the SBIR program (See Figure II) effectively functioning in that agency since 1977.

Figure II

SBIR Program Format

Phase I	**Federal Monies**	**— Scientific and technical feasibility proposal in response to agency research needs solicitation** **— to $50k (more in Defense)** **— half a year of effort**
Phase II		**— Prototype development proposal. Research merit and business prospects** **— $100k - $500k** **— 1 - 2 years** **— Private sector commitment and market assessment**
Phase III		**— Commercial market development using private sector support** **— Federal application under government procurement contract**

Congress further established a Phase-in schedule for the dollar commitment to be made (See Figure IV) - four years in the civilian agencies, five years in Defense - with a six year sunset provision to permit a full and comprehensive review of the achievements of the program in 1988.

Table IV

Department of Defense

Department of Health and Human Services

National Aeronautics and Space Administration

Department of Energy

National Science Foundation

Environmental Protection Agency

Nuclear Regulatory Commission

Department of Interior

U.S. Department of Agriculture

Department of Transportation

Department of Education

Department of Commerce

Figure III

Program Phase-In

	Civilian Agencies	**DoD**	**Annual Funding (in millions) (rounded)**
FY83	2%	1%	$ 45
FY84	6%	3%	$ 137
FY85	1.0%	5%	$ 250
FY86	1.25%	1.0%	$ 428
FY87	1.25%	1.25%	$ 532
Total			$1,392

Civilian Agencies - 4 Years
Department of Defense - 5 Years

At this point we are in the third year of the program. The solicitation and submission cycle for FY 85 is completed in nine of the twelve agencies (See Figure III in Appendix II for FY 85 SBIR Solicitation Schedule), the evaluation and selection process of both new Phase I's and the second group of Phase II's is underway, with announcement of awardees expected in the Summer and early Fall.(1)

Program objectives:

The enabling legislation established the SBIR program to meet two primary objectives:

1. to encourage and support the greater involvement of the qualified, technology-based small firm in the federal procurement process

2. to target that support towards development of technology which would find application - i.e. to complete the innovation process, to use what we know. (See attached as Appendix III - What is the national question to which SBIR is an answer? InKnowVation, November 1983 - (2))

Progress towards the first objective has been rapid - in the agency's first report on the program, the U.S. Small Business Administration, with SBIR oversight responsibility, determined that only 20 percent of SBIR Phase I awardees in the first year of the program had had any previous or recent federal procurement experience (SBA Report Number 453, February 21, 1984). These findings were broadly substantiated by those of i d i in a recent in-depth study of SBIR usage among small firms in the State of Masschusetts. Though Massachusetts's firms have had a strong SBIR presence both in the early NSF and DESAT programs and now in the expanded effort, only 46.2 percent of responding firms reported their principals as having previous procurement experience, with only 7.7 percent assessing that experience to have been substantial. (3)

There is also evidence - as yet anecdotal - that, particularly in the Department of Defense and NASA, but also in the other mission agencies, that qualified, SBIR-active firms are establishing the contacts, and developing the opportunities that will translate into a more active presence in the regular federal procurement.

These are very early days. Two years of activity and results do not make a trend. More specifically, in the time-frameworks generally required to achieve market penetration of new products and processes - minimally seven to

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1. The exception will be the National Science Foundation (NSF). Although the agency's solicitation is issued and response solicited in the broadly the same time period as the other agencies, the continuance in NSF of the original SBIR program has the effect of moving selected projects into the following year's funding. In consequence, NSF SBIR awards are generally made six months after the due date for submission, in the New Year.

2. Focused primarily to effective use of the SBIR program, InKnowVation is the nationally distributed newsletter published by the Innovation Development Institute (i d i), Swampscott, MA.

3. SBIR: A survey examining the characteristics of, and factors in program usage by small firms in Massachusetts 1977-84. Report prepared by i d i, Jan. 1985 with partial funding from the Massachusetts Department of Commerce and Development.

eight years, potentially twelve to fifteen in some fields - we have barely begun. Clearly no major technological breakthrough, nor substantial business development can be claimed for SBIR. Nor is it obvious that, even those involved early in the program, they will have had time to complete that process in the six year period within which the program overall will be assessed.

Nevertheless, it is apparant that progress has been made towards these objectives and the testimony of the several awardees here today will speak to that. A diversity of small firms all over the country are being brought into the program, a level of enthusiasm and a climate established which, if nurtured and allowed to develop, gives cause for considerable optimism.

Program statistics: (4)

Over the six year period to the end of FY 88, it is estimated that $1.32 billion will have been distributed out of the participating federal agencies, expected to support over 5000 feasibilty Phase I projects with as many as 1350 of these selected for continuance into the more substantial effort of Phase II.

To date, not including the anticipated FY 85 awards nor the most recent Phase II's in NSF, 1771 Phase I projects have been selected - 781 in FY 83, 990 in FY 84. 274 of these projects are presently in the first of two years of Phase II investigation, with an estimated additional 350 new Phase II's expected to be announced before the end of this fiscal year. (By-agency break-out of awards, Phase I and Phase II, FY 83-84 - Figure V, Appendix IV).

Involvement in the States:

The early NSF SBIR program, and that administered voluntarily in the Department of Defense for one year (DESAT), were largely dominated by firms in the two states of California and Massachusetts.(5) The 128 (now 495) and Silicon Valley phenomenon, fostering the small, technology-based firm, was reflected in that condition. Firms in these two states continue to be a strong presence

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4. Some discrepancies will be noted between the numbers referenced by different sources. This primarily reflects the dynamics of the small business condition i.e. between the times of submission, selection and award, the condition of some applicant firms selected for award has changed (change of ownership, acquisition, growth to larger than 500 employees, gone out of business etc) resulting in fewer contract negotiations e.g. in DOD, DOE and in NASA) than were announced in the original listings.

5. The form of SBIR usage in the two states is fundamentally different - the number of applications/ received award in California is substantially greater than almost any other state including Massachusetts. Far more California firms are in receipt of awards than in Massachusetts, with a prevailing pattern of single awards and a greater % of discontinuance (drop-out from one year to the next) - discussed later. While Massachusetts firms have tended to cluster in the research activity, California firms are more diverse though, reflecting the state's industrial base, with the dominating presence in DOD.

in the expanded program, having taken 38.9 percent of the total number of awards in FY 83, and 36.46 percent in FY 84.

However, firms in these two states are ill-advised to rest on their laurels.

- SBIR informational briefings and conferences are being organized all over the country.
- In several states, a concerted effort is being made, involving the public and private sectors and representatives of the region's academic community to encourage and support the successful involvement of the qualified small firms in the program.

In Pennsylvania and New York, for example, in-depth training programs have been developed and offered around the state, local counselling made available, and opportunities to compete for state provided funds tied into that effort - in Pennsylvania, the Ben Franklin and the seed grants program; in New York, the funding by the State Assembly of an SBIR matching grants program under which any firm successfully completing a Phase I SBIR project and submitting a Phase II application receives a matching grant from the state equivalent to the amount of the Phase I award (though not to exceed $50,000 per project). This particularly useful approach is designed directly to address the dilemma of the Phase I - Phase II funding lag which is characteristic of the program in several of the agencies.

These efforts are already showing results - a greater level of program participation in FY 83 compared to the earlier program, a much stronger presense in FY 84 and good program retention levels in those states.

SBIR: Credibility and Leveraging Factor

Before addressing the activity level in the states and the issue of retention, a word about why the states would go to all this trouble. Friendly inter-state rivalry aside, in the overall scheme of things, in any one year the amount of money in the SBIR kitty is not large - $250 million this year, $428 million next - and the amount which will flow into even the most active states is not substantial. However, what is also critical is the potential leveraging to other resources which the successful program participation brings.

In the early NSF program it was determined that more than 40 percent of awards were taken by firms employing fewer than 10 people (almost 20 percent one and two-man shops). The results of a recent survey of Massachusetts SBIR involved firms which my firm undertook (referenced above) suggests that, although eligibility extents to firms with 500 employees, the major percentage of participants will continue to be the smaller (and younger) firm. Our results showed only 15 percent of SBIR-active firms in the State of Massachusetts to employ more than 51 people.

In the earlier SBIR program, it was apparant that for the larger, small firms, the resource commitment required to compete for the very small awards of the early program ($25K in NSF, later raised to $35K, now at $40K) plus the limited and often delayed prospects for Phase II award rendered the program less interesting to them. (6)

In the expanded program, both the increased resource availability and the assurance of continued, and more substantial flow of Phase II, has attracted their attention. (7) Perhaps more critical than the dollar value of the single award, however, these firms identify the technical credibility factor as a primary reason for their interest and participation - factor which, though less frequently referenced by the smaller firm, is perhaps even more importnat for them.

SBIR is a highly competitive program - perhaps among the most competitive in federal procurement. Though the ratio of submitted proposals to Phase I awards narrowed from the extraordinary levels of the first year of the program (see Figure VI in Appendix VI), these ratios still calculate to 8:1 overall in the five larger agencies (8), with a wider spread in the seven smaller programs.

The Phase II evaluation procedure is rigorous, and any firm which successfully proceeds through that process to selection for an award can rightly claim evidence of technical competence. That evidence, especially when substantiated by Phase II selection(s), as among the awardees here today, identifes that firm as on the leading edge in their field, reducing in one critical area, the high risk profile which that firm presents to outside funding sources, or in other federal procurement opportunities.

In other words, an SBIR funded project (Phase I and Phase II) successfully pursued, can serve a vital function as a certificate of technical competency in that firm. By itself, that will not assure the firm access to the more substantial resources required to complete the innovation process, nor that that process will result in the technical breakthrough and business development to successful new products or processes, but it is a valuable, and potentially key element in that task.

In the preceding NSF program, for example, it has been estimated that for every one dollar of federal funds allocated to small firms through the department's SBIR program, up to eight (8) private sector dollars were accessed by the participating firms - a remarkable 8:1 leveraging factor that few other federal programs can match.

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6. For the resource-starved very small firm, these were problems they chose to live with.

7. Though it should be noted that they are still, in large part, being out-stripped in that effort by the more fleet of foot, very small, early-stage firm.

8. The exception to this highly competitive condition are the special circumstances which apply in the National Institutes of Health (NIH). For several reasons which we can discuss, the number of submissions into NIH-SBIR is proptionately low. Though the shortened odds represent a bonus to applicant firms in the near term, an important emphasis in future implementation efforts must be assisting NIH program administrators towards increasing substantially the number of quality applications to that agency.

The NSF SBIR firms were small in number and the results perhaps skewed by the substantial achievements of a few firms. In the context of the expanded program, therefore, it might more conservatively be suggested that a leveraging ratio of 5:1 could be readily achieved.

Even at these levels, however, factored out, the impact of successful SBIR involvement for the particular firm and, by extension, for the region in which they are located, can be impressive. Using for example, only the first year of program participation in the State of Massachusetts (as noted above, one of the most active and successful in the program overall), in FY 83, firms in the state

- took a total of 142 Phase I awards, representing a federal dollar commitment of approximately $7 million
- converted 52 of those awards into Phase II, representing a follow-on federal commitment over two years of an estimated $18.2 million .

Factoring to the 5:1 leveraging rate suggested above, that represents a potential commitment into those firms, and into the state, of over $90 million for FY 83 initiated projects alone. (see Figure VII below). Maintaining approximately the same levels of involvement each year (as Massachusetts' firms seem to be), over the six years of the program, it is estimated that over $150 million in federal SBIR funds could flow into the state, rendering the potential of $750 million of private sector commitment (or other non-SBIR federal contract work) towards completion of the innovation process - translating into new jobs improved productivity, increased international competitiveness etc.

Figure VII

SBIR Leveraging Factor

Massachusetts FY 83

Phase I (142) — $ 7 million in awards

Phase II (52) — $18.2 million in awards

Phase III commitment — potentially $91 million

Though less dramatic, even in those states with a less substantial (though growing) SBIR presence - Pennsylvania, Virginia, New York - the same type of substantial accumulated impact can be documented.

Number and distribution of SBIR participating firms - 1983-84:

Though estimates of the number of small firms qualified to participate in SBIR ran high (25 -30,000), since passage of the enabling legislation a total of 1000 firms have been in receipt of an award (9) - distribution of these firms by-state and by year of successful entry into the program is given in Table V (attached) (9).

As would be expected from the discussion above, California has by far the largest number of firms involved to date (239), with Massachusetts (with 101) in second place. By this measure, strong (and growing) levels of participation are evident in Colorado, Florida, Maryland, New York, Ohio, Pennsylvania, Texas and Virginia.

Particularly interesting is what can be defined as Retention Rates in the states. Calculated as the percentage of firms with an on-going SBIR presence in FY 84 (continuance into Phase II and/or additional FY 84 Phase I award(s)), this analysis reveals a pattern of activity that is notably more cohesive in some states than in others, suggesting a more effective use (and understanding) of the program. In general, these areas correspond to those in which the concerted effort to support the qualified firm (referenced above) is occurring.

As the program, and the projects it supports, develops, more firms are expected to 'graduate' through the process, becoming correspondingly less involved in the feasibility efforts of Phase I, instead focusing to the more substantial requirements of Phase II. As a practical matter, therefore, states which wish to retain continuing SBIR presence are well advised to maintain a partial emphasis on drawing a flow of 'new' firms into the process.

Phase I - Phase II Conversion - by-state

It has been our experience that effective use of the SBIR program by the firm is not simply that of racking up the numbers of either applications, or Phase I awards. Rather, it is the capacity in the firm carefully to match their primary strengths to the research interests of the participating agency (10)

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9. Not including the recently announced NSF awards, nor the additional awards to be made in the Department of Defense.

10. Though each of the agencies proceeds from the same basic structure and program format - open solicitation, technical evaluation, Phase I, Phase II etc - as the program is developing, each agency (and service) is adapting the program effort so that it is becoming more consistent with that of the general procurement effort. In an important sense, therefore, rather than one SBIR program, it might almost be suggested that there are sixteen (11 in the civilian agencies plus that in the Air Force; Navy; Army; DARPA and DNA). Effecttive SBIR involvement is that in which the firm has clearly taken the time to understand these consequent differences and to factor to them in the submitted proposal.

Table V

Number of SBIR Firms 1983-4[1] By Activity Level and Retention Rates[2]

State[3]	FY 83	Ongoing	Retention*	FY 84	Total *
Alabama	4	4	50	9	17
Arizona	3	4	57	5	12
Arkansas	0	1	100	0	1
California	63	60	49	116	239
Colorado	8	7	47	14	29
Connecticut	7	5	42	6	18
District of Columbia	3	3	50	4	10
Delaware	0	2	100	1	3
Florida	5	3	38	13	21
Georgia	1	3	75	3	7
Hawaii	0	1	100	0	1
Idaho	0	1	100	3	4
Illinois	6	6	50	9	21
Indiana	2	2	50	9	21
Iowa	0	0	0	3	3
Kansas	1	0	0	3	3
Kentucky	0	1	100	0	1
Louisiana	1	0	0	2	3
Maine	0	2	100	3	5
Maryland	17	13	43	23	53
Massachusetts	21	51	71	29	101
Michigan	8	4	33	9	21
Minnesota	1	3	75	6	10
Mississippi	0	1	100	1	2
Missouri	1	1	67	2	5
Montana	0	0	0	2	5
Nebraska	2	1	33	2	5
Nevada	1	1	50	1	3
New Hampshire	4	2	33	3	9
New Jersey	10	7	41	19	36
New Mexico	4	4	50	7	15
New York	11	11	50	20	42
North Carolina	6	8	57	2	16
Ohio	9	14	61	19	42
Oklahoma	2	0	0	3	5
Oregon	2	1	33	6	9
Pennsylvania	7	13	65	18	38
Rhode Island	1	1	50	2	4
South Carolina	0	0	0	1	1
South Dakota	0	0	0	1	1
Tennessee	3	3	50	7	13
Texas	11	9	45	22	42
Utah	3	6	67	2	11
Vermont	0	0	0	1	1
Virginia	22	17	44	31	70
Washington	6	12	75	1	5
	257	292	53	451	1000

[1] Not including NSF Phase II, NSF FY 84 Phase I's, or additional DOD Phase II's to be announced.

[2] Retention rate calculated as the number of firms with Ongoing Activity in FY 84 (continuance into Phase II and/or additional FY 84 Phase I's) divided by the total number of firms involved in SBIR in that state during FY 83.

[3] No SBIR activity during this period in Alaska; North Dakota; West Virginia or Wyoming. Not included in this table.

Source:

InKnowVation

March-April 1985
Volume II, No. 5

The firm which so targets its efforts has the greater likelihood - as represented by those who will testify today - of successfully converting selected Phase I project(s) to Phase II.

In the first set of Phase II awards (FY 83 onset), 274 awards were made to 221 firms, 39 firms taking more than one award. The by-state breakout of these Phase II awards is included here as Table VI (attached).

Use of the program:

In contact with, and study of, SBIR involved firms, we have found that, depending on the age of the firm, the stage of development of the technology, the industry focus and objectives of the firm, as a resource, the awards are being used

- to support development of the technology overall, thus to strengthen the intellectual property of the firm for
- to examine and support potential applications of a technology previously developed
- in the more established firm, to investigate the next generation of products which will support the firm's continued development and operations.

Focusing to Phase III

While it seems likely that the percentage of SBIR firms which go on to significant growth utilizing venture capital, public offerings etc will probably be greater among SBIR awardees than among the general population of small, technology-based firms, substantial growth seems largely to be neither an option nor an objective in many of the firms.

More commonly, the evidence suggests that completion of the innovation process - taking the initial idea for a new product/ process through al the stages of research, development and demonstration into commercial or other application - for the SBIR firm will be achieved through some form of technology transfer and/ or integration effort. That is, consistent with the demonstrated strengths of technology-based small firms as a population, the effective use of their developed technologies will largely be achieved by customized development to a high value-added, specialist market; by licensing, joint venture or sub-contracting arrangements; and only for a few, by any major refocusing of the efforts of the firm towards the high growth conditions of substantial manufacturing and/ or distribution.

In conclusion, matching the high levels of interest in SBIR by qualified small firms is a growing interest by those who will, in many cases, be part of the Phase III achievement. The number of developed relationships to the venture community, to large firms and others with the reosurces required to complete the innovation process are as yet few, but they exist - some will be the subject of testimony today - and they will increase as the program, and the technology development it supports, matures.

In the meantime, if imitation is the sincerest form of flattery - and evidence of success - it should be noted that there is strong indication that SBIR-like programs are being considered in other countries - Britain and the Netherlands for example - anxious to promote the growth and contribution to the economic health of the nation of their technology-based small business community.

We are aware that pockets of resistance and opposition to SBIR, conceptually and practically, continue to exist. However, among those who are using this important new program, and those who understand it use, the assessment is uniformly positive. This program works, allowing the best among this nation's technically competent to fulfil their long-time role as contributors into the vital innovation process.

Appendix 1

Figure 1

Procurement Dollars by Type
FY 82 ($147 billion)

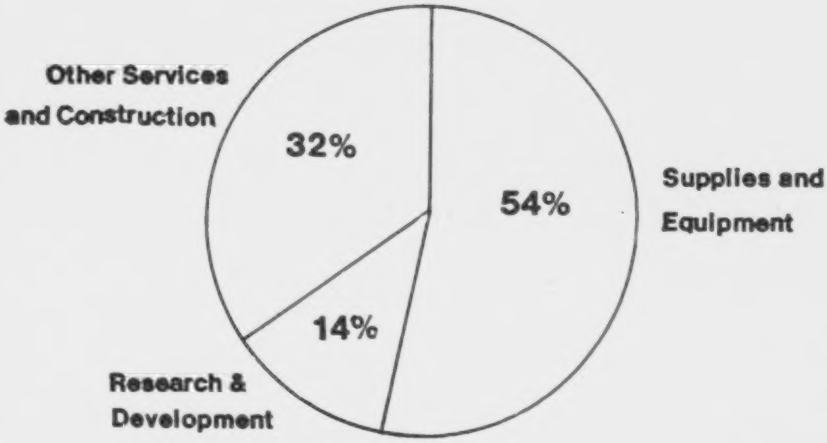


Table 1

Contract Action by Type of Product or Service
FY 80 and 82 Small Business Share

Category	FY 82 (000 $)	Small Bus. Share FY 80 (%)	Small Bus. Share FY 82 (%)
Research & Development	19,992,902	6.73	4.68
Other Services and Construction	47,834,301	20.02	19.76
Supplies and Equipment	79,158,916	13.73	14.25

Source: Federal Procurement Data Center - as reported in
State of Small Business: Report to the President 1984

Table II

Federal Contract Actions Over $10.000
FY 79–82 Small Business Share

Fiscal Year	Total	Small Business Awards	Small Business Percent
82	$146,986,119	21,670,707	14.7
81	128,641,261	19,867,449	15.4
80	100,853,143	15,324,174	15.2
79	88,309,059	14,001,858	15.9

Table III

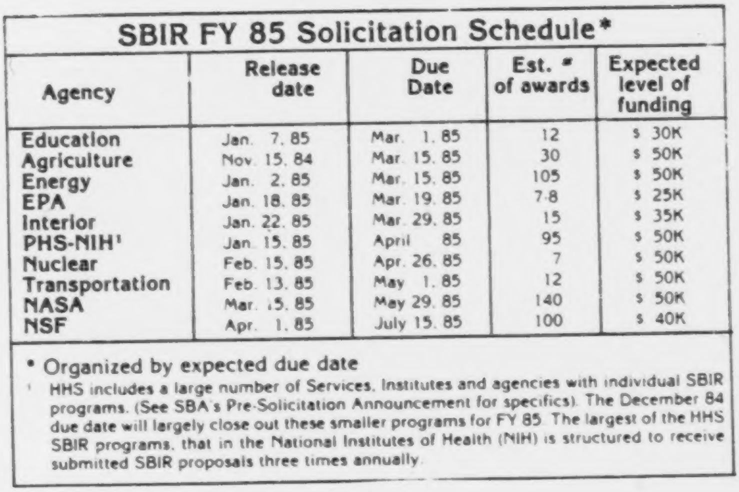
Table 6.8 *Small Business Share of Federal R&D Contract Actions Over $10,000 by Agency, FY 1979–FY 1982*

	FY 1982 (Thousands of Dollars)		Small Firm Percentage			
	Total	Small Firms	FY 1982	FY 1981	FY 1980	FY 1979
Department of Defense	14,483,953	717,801	4.96	6.43	6.16	6.29
National Aeronautics and Space Administration	2,889,084	45,024	1.56	2.01	2.26	2.29
Department of Energy	1,410,711	44,444	3.15	3.42	7.42	9.27
Department of Health and Human Services	345,078	44,516	12.90	9.65	8.89	8.21
Environmental Protection Agency	124,288	35,270	28.38	33.76	38.53	36.91
Department of the Interior	57,479	13,996	24.35	26.09	32.02	19.74
Department of Transportation	56,016	20,173	36.01	34.07	38.96	22.99
National Science Foundation	43,376	—	—	0.03	0.36	1.03
Department of Education	17,084	2,713	15.88	46.54	7.82	8.83
Department of Commerce	16,271	3,112	19.13	33.49	42.15	18.35
Nuclear Regulatory Commission	12,761	543	4.26	8.11	40.79	25.43
Department of Labor	7,031	295	4.20	1.79	10.41	3.41
Agency for International Development	6,213	622	10.01	18.71	13.87	14.57
Federal Emergency Management Agency	3,574	1,892	52.94	25.29	19.26	10.57
Department of Housing and Urban Development	3,531	731	20.70	7.14	4.84	21.72
Department of Agriculture	3,396	2,455	72.29	31.35	75.16	27.86
Veterans Administration	1,874	507	27.05	30.55	26.70	32.30
Arms Control and Disarmament Agency	1,057	590	55.82	10.52	31.77	37.44
Department of Justice	856	468	54.67	5.00	18.78	4.67
Tennessee Valley Authority	770	—	—	—	0.57	1.54
Department of State	21	—	—	100.00	48.04	—
Other 10 Agencies	1,007	583	57.89	52.92	13.84	90.88
Total	**19,485,431**	**935,735**	**4.80**	**5.96**	**6.81**	**6.69**

Source: Federal Procurement Data Center, Special Report 395, 14 April 1983. The "other 10 agencies" did not have R&D contract actions over $10,000 in each of the four fiscal years.

Appendix II

Figure IV



SBIR FY 85 Solicitation Schedule*

Agency	Release date	Due Date	Est. # of awards	Expected level of funding
Education	Jan. 7, 85	Mar. 1, 85	12	$ 30K
Agriculture	Nov. 15, 84	Mar. 15, 85	30	$ 50K
Energy	Jan. 2, 85	Mar. 15, 85	105	$ 50K
EPA	Jan. 18, 85	Mar. 19, 85	7-8	$ 25K
Interior	Jan. 22, 85	Mar. 29, 85	15	$ 35K
PHS-NIH[1]	Jan. 15, 85	April 85	95	$ 50K
Nuclear	Feb. 15, 85	Apr. 26, 85	7	$ 50K
Transportation	Feb. 13, 85	May 1, 85	12	$ 50K
NASA	Mar. 15, 85	May 29, 85	140	$ 50K
NSF	Apr. 1, 85	July 15, 85	100	$ 40K

* Organized by expected due date

[1] HHS includes a large number of Services, Institutes and agencies with individual SBIR programs. (See SBA's Pre-Solicitation Announcement for specifics). The December 84 due date will largely close out these smaller programs for FY 85. The largest of the HHS SBIR programs, that in the National Institutes of Health (NIH) is structured to receive submitted SBIR proposals three times annually.

Source:

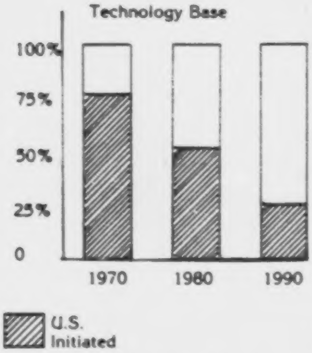
InKnowVation

Published by:
Innovation Development Institute
Swampscott, MA 01907

Appendix III

What Is The National Problem To Which SBIR Is An Answer?

In his remarks as the Small Business Innovation Development Act was signed into law, July 22, 1982, President Reagan referred to small business as "the tonic for what ails this country".



Percentage of World Technology-Base Initiated in the United States

Concern about what ails this country, and other mature industrialized areas, had much to do with the passage of SBIR, the design of the program, and its effective use by applicant small firms.

Few of the ascribed benefits of innovation — more jobs, improved productivity, increased competitiveness, and a healthier business climate, individually or collectively — are achieved until the technologies under development are put into use. In other words, until new products and processes are available that someone — the government, another business or an individual consumer — is willing to pay for, the process of innovation is not completed, and the economic condition of the firm, or the nation, is not affected.

U.S. initiated Technology:

Indicative of this condition is the bar-graph in Figure 1 adapted from an article by D. Bruce Merrifield, currently the Assistant Secretary for Productivity, Technology and Innovation in the U.S. Department of Commerce.

As recently as 1970, 70% of the world's technology base had been initiated here in the United States. By 1980, that percentage had dropped to almost 50%, and all indications are that by the end of this decade, that percentage will have dropped further to less than 25%.

It is not that scientists and engineers working in the United States have become any less capable. This country continues to dominate the major scientific fields. Current, and past announcements of the Nobel prizes are evidence of that. However, as this nation's efforts are cut back in some areas, and only the *status quo* is maintained in others, other nations of the world are building to their strengths and rapidly are catching up.

Not Only R & D:

Much attention has been focused on R&D expenditures, nationally and within particular firms, and its importance is appropriately stressed. There is no question that a strong commitment to research, basic and applied, is fundamental to the continued health of an industrialized economy. To cut indiscriminately into research budgets is to feed on our seed corn.

However, though a sound base in research is needed, a strong commitment also must be made to effective use of the knowledge generated.

If there is a single condition which underscores the success of the Japanese and some of the emerging, industrializing nations, it is that they consistently seek out, build upon, and apply what is known to solution of defined problems.

The SBIR Objective:

In the context of SBIR, instead of Eureka — I found it, one perhaps should exclaim E polesa — I sold it!

Invention v. Innovation

Eureka — I Found It!

Versus

Epolesa — I Sold It!

Though the primary criteria of evaluation for both Phases I and II will continue to be those of scientific and technical competence, in the priorities used to select between projects of similar quality when more are recommended for funding than there is money to support, OR when Phase II choices must be made, those projects of potentially greater utility will have the edge.

Effective use of SBIR is that which factors into the development of the project consideration of how the Process of Innovation is to be completed, and the idea taken through all the stages of research, development and demonstration into the condition of application that will make the firm, and the nation, competitive□

Defense Department SBIR Program Update: 83 Awards; 84 Solicitations

Though phased in over a longer period and at smaller percentages than the other ten agencies participating in SBIR, the Department of Defense nevertheless represents a budget total for the program that is more than double that of the next largest research agency, the National Institutes of Health. In addition, the research interests of DOD, spread across the Services (Army, Navy and Air Force), Defense Advanced Research Project Agency (DARPA), and the Defense Nuclear Agency (DNA), cover the gamut of R&D work likely to be conducted in small firms.

DOD SBIR Budget Phase-In	
Fiscal Year	**Total $ (in million)**
83	16.70
84	46.00
85	79.00
86	106.00
87	204.00
88	262.00
Total	$713.70m

Preceding passage of the SBIR legislation, Defense had initiated a version of SBIR, designated DESAT which in 1981 had funded 103 Phase I projects selected from 1100 DoD had received in response to their open solicitation. Hence, at the time of passage of the SBIR enabling legislation there was already some familiarity with what was involved both within the agency and the responding small business community.

Fiscal 83 figures:

Given these conditions, it was not unexpected that DOD would draw the lion's share of submitted SBIR proposals this first year of the full program for a total of 2902 submissions.

From a Fiscal 83 SBIR budget of $16.7 million, estimates on how much would be available to support selected new Phase I projects were of necessity only provisional. Until very recently, decision had not been made on how much of this year's budget would be allocated to support the earlier DESAT projects selected for Phase II funding. In fact, 33 of those projects have now moved into the prototype development, apparently only partially utilizing current SBIR funds.

In common with several of the agencies, the number of projects favorably evaluated and recommended for funding in DoD, exceeded the total number of awards that the agency provisionally had indicated would be supported. Originally, that estimate in Defense had been 200+. As the evaluations began to come in, that figure was adjusted upwards to 230-240, and the most recent indications are that as many as **275 Phase I awards** may be announced later this month.

Budget Allocations:

Within the total budget for SBIR in DoD, the different services and research entities in the agency function separately. Army, Navy, Air Force, DARPA and DNA all develop projects to be included in the SBIR solicitation which is prepared and distributed by the Defense Department's established SBIR office. Submitted proposals are received by this central administrative office which then, by topic area, are distributed back to the services for evaluation.

Though Army had the largest number of topics in the FY 83 solicitation, and received by far the largest number of submitted proposals — a total of 1250 of the overall 2902 — in fact Army has the smallest of the three services budgets. For Fiscal 84, the figures run $8 million in the Army SBIR Budget, compared to $16 million in the Navy and $20 million for Air Force. (see chart Budget: by Service)

Cont. on page 5

SBIR: Strategies for Success In-Depth Conference Scheduled

As noted elsewhere, the mailing list maintained by the U.S. Small Business Administration has more than 25,000 entries. SBIR Conferences, briefings and workshops have been held all over the country attended by thousands of interested persons, more are scheduled, and the level of attention continues strong.

In some states less active in the SBIR program previously, it may be that firms qualified to apply into SBIR have not yet heard of the program. In large part, however, the grapevine has been effective and one can assume that for many the acronym SBIR has some meaning and is not simply part of the bureaucratic alphabet-soup.

Nevertheless, how to use the program effectively is still not well understood, even among those firms which may have been successful in making application for award. Clearly a primary task in FY 84 is to address successfully the tasks of:

- upgrading the quality of submitted proposals overall, and
- assisting firms to focus projects towards viable applications of the developed technologies.

Information about, recommendations for, and analysis of that effective use will continue to be an important part of InKnowVation's content, and of the other activities of idi.

As part of that effort, in cooperation with the Smaller Business Association of New England (SBANE), an all-day working conference has been scheduled for Monday, 31 October, 1983. Entitled SBIR: Strategies for Success, the event will be held at the Sheraton Boxborough Inn on Route 495, north of Boston, MA.

The conference is expected to draw an attendance of 300-400 people from several states. From the assumption that no-one can speak better to the opportunities, problems and conditions of SBIR usage than those who have been actively involved in the program for some time, several SBIR long-term winners have been scheduled into the program, and others are expected to participate less formally.

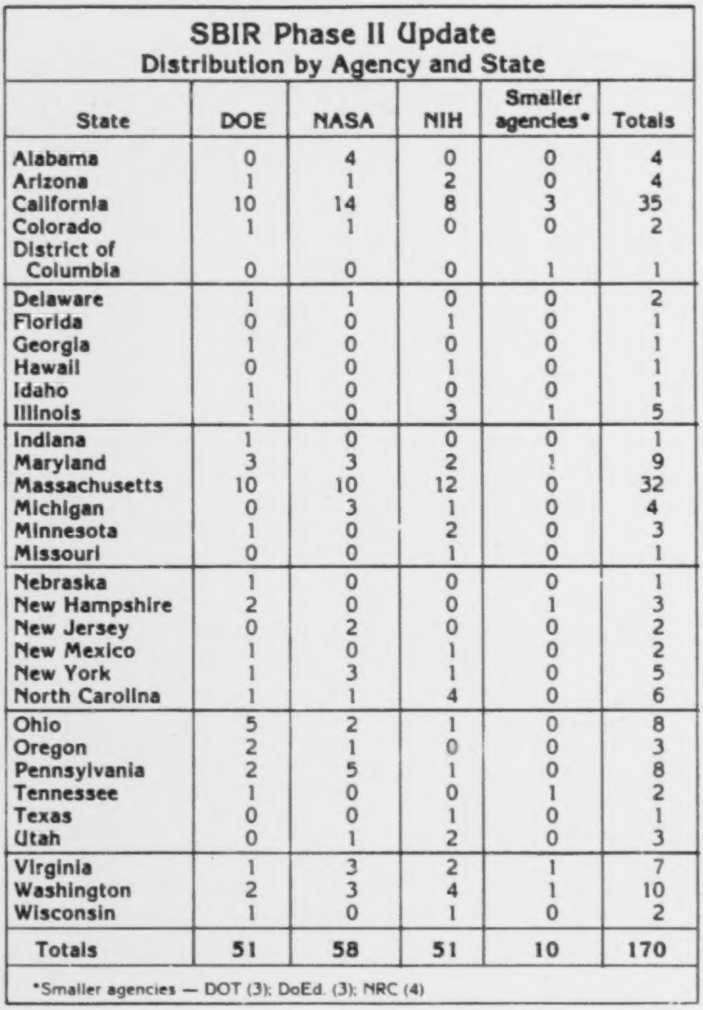
Conference Program

Eighteen workshops have been developed and a number of plenary sessions, organized around two primary themes:

- effective application into the program, and
- consideration of the business development aspects of SBIR.

Representatives of the five larger agencies will be present and two of the smaller program managers.

Appendix IV By-Agency Breakout SBIR Awards
Phase I and Phase II FY 83-84



SBIR Phase II Update
Distribution by Agency and State

State	DOE	NASA	NIH	Smaller agencies*	Totals
Alabama	0	4	0	0	4
Arizona	1	1	2	0	4
California	10	14	8	3	35
Colorado	1	1	0	0	2
District of Columbia	0	0	0	1	1
Delaware	1	1	0	0	2
Florida	0	0	1	0	1
Georgia	1	0	0	0	1
Hawaii	0	0	1	0	1
Idaho	1	0	0	0	1
Illinois	1	0	3	1	5
Indiana	1	0	0	0	1
Maryland	3	3	2	1	9
Massachusetts	10	10	12	0	32
Michigan	0	3	1	0	4
Minnesota	1	0	2	0	3
Missouri	0	0	1	0	1
Nebraska	1	0	0	0	1
New Hampshire	2	0	0	1	3
New Jersey	0	2	0	0	2
New Mexico	1	0	1	0	2
New York	1	3	1	0	5
North Carolina	1	1	4	0	6
Ohio	5	2	1	0	8
Oregon	2	1	0	0	3
Pennsylvania	2	5	1	0	8
Tennessee	1	0	0	1	2
Texas	0	0	1	0	1
Utah	0	1	2	0	3
Virginia	1	3	2	1	7
Washington	2	3	4	1	10
Wisconsin	1	0	1	0	2
Totals	**51**	**58**	**51**	**10**	**170**

*Smaller agencies — DOT (3); DoEd. (3); NRC (4)

Source:

InKnowVation

Published by:
Innovation Development Institute
Swampscott, MA 01907

DOD SBIR Results

State	FY 84	FY 83	Change	State	FY 84	FY 83	Change
AL	10	9	+ 1	NC	2	3	— 1
AR	0	1	— 1	NE	0	1	— 1
AZ	1	1	NC	NH	4	4	NC
CA	89	74	+ 15	NJ	8	7	+ 1
CO	9	8	+ 1	NM	7	7	NC
CT	12	8	+ 4	NV	1	0	+ 1
DC	0	2	— 2	NY	8	6	+ 2
FL	9	3	+ 6	OH	20	13	+ 7
GA	4	2	+ 2	OK	3	1	+ 2
IA	1	0	+ 1	OR	5	1	+ 4
IL	8	3	+ 5	PA	17	8	+ 9
IN	2	1	+ 1	RI	2	2	NC
KS	0	1	— 1	SD	1	0	+ 1
KY	1	1	NC	TN	1	5	— 4
LA	0	1	— 1	TX	10	9	+ 1
MA	45	39	+ 6	UT	0	4	— 4
MD	16	11	+ 5	VA	36	28	+ 8
ME	2	3	— 1	VT	1	0	+ 1
MI	7	4	+ 3	WA	5	8	— 3
MN	3	1	+ 2	WI	0	1	— 1
MO	1	0	+ 1				
MS	1	0	+ 1	TOTAL	352	281	+ 71

DOD SBIR Phase II Distribution

State	Phase I FY 83	Phase II Award	Conversion Rate (%)	State	Phase I FY 83	Phase II Award	Conversion Rate (%)
Alabama	9	2	22.2	N. Carolina	3	1	33.3
Arkansas	1	1	100.0	Nebraska	1	0	00.0
Arizona	1	1	100.0	New Hampshire	4	1	25.0
*California	75	25	33.3	New Jersey	7	1	14.3
*Colorado	8	3	37.5	New Mexico	7	0	00.0
Connecticut	9	4	44.4	Nevada	1	0	00.0
District of Columbia	1	0	00.0	New York	6	2	33.3
Florida	3	1	33.3	Ohio	13	4	30.8
Georgia	2	1	50.0	Oklahoma	1	0	00.0
Illinois	3	1	00.0	Oregon	1	1	100.0
Indiana	1	0	00.0	Pennsylvania	8	2	25.0
Kansas	1	0	00.0	Rhode Island	2	1	50.0
Kentucky	1	0	00.0	Tennessee	5	2	40.0
Louisiana	1	0	00.0	Texas	9	1	11.1
*Massachusetts	40	18	45.0	Utah	4	1	25.0
Maryland	11	2	18.2	Virginia	28	8	28.6
Maine	3	0	00.0	Washington	7	2	28.6
Michigan	4	1	25.0	Wisconsin	1	0	00.0
Minnesota	1	0	00.0	Totals	283	86	30.4

DOD SBIR Program FY 83 - 84
By Service Data

FY 83

Services	* Proposals received	Phase I Awards	Award Ratio[1]	Phase II Awards	Conversion Percentage
Army	1121	96	12:1	20	20.8
Navy	944	67	14:1	9(+ 27)[2]	53.7
Air Force	496	100	5:1	47(+)[3]	50.0
DARPA	128	12	11:1	8	66.7
DNA	88	8	11:1	2	25.0
Totals	2777	283	10:1	86(+ 30)	41:1

FY 84

Services	* Proposals received	Phase I Awards	Award Ratio[1]
Army	761	78	10:1
Navy	847	101	8:1
Air Force	1212	162	8:1
DARPA	107	15	7:1
DNA	80	12	7:1
Totals	3007	368	8:1

[1] Number of submissions to number of awards (rounded up)

[2] Navy is currently negotiating an additional 27 Phase II awards for a total of 36

[3] Air Force will be awarding an additional $744 596 in Phase II contracts — recipient firms not yet announced

Source: **InKnowVation** Published by: Innovation Development Institute Swampscott, MA 01907

HHS/NIH SBIR Awards FY 84

State	Phase I	Phase II	State	Phase I	Phase II
Alabama	2	0	Michigan	9	1
Arizona	1	2	Minnesota	3	2
California	41	8	Mississippi	1	0
Colorado	3	0	Missouri	1	1
Connecticut	3	0	Nebraska	1	0
District of Columbia	1	0	New Hampshire	1	0
Delaware	1	0	New Jersey	6	0
Florida	2	1	New Mexico	3	1
Georgia	5	0	New York	16	1
Hawaii	0	1	North Carolina	3	4
Idaho	1	0	Ohio	4	1
Illinois	6	3	Oregon	6	0
Indiana	3	0	Pennsylvania	7	1
Iowa	2	0	South Carolina	1	0
Kansas	1	0	Tennessee	2	0
Kentucky	1	0	Texas	7	1
Louisiana	1	0	Utah	4	2
Maine	2	0	Virginia	6	2
Maryland	10	2	Washington	9	4
Massachusetts	36	12	Wisconsin	0	1
			Totals	211	51

Interior Department: SBIR Results

State	FY 83	FY 84	Change
CA	1	4	+3
CO	1	1	0
MA	1	0	—1
MD	0	1	+1
MT	0	1	+1
NJ	0	1	+1
OH	0	1	+1
OR	0	1	+1
TX	2	0	—2
UT	0	1	+1
VA	0	1	+1
WA	1	1	NC
Totals	6	13	+7

Energy SBIR Results

State	FY 84	FY 83	Change
AL	1	0	+ 1
AZ	0	3	— 3
CA	17	21	— 4
CO	4	2	+ 2
CT	3	3	NC
DE	0	1	— 1
FL	1	1	NC
GA	1	1	NC
ID	0	1	— 1
IL	1	2	— 1
IN	1	1	NC
LA	2	0	+ 2
MA	26	25	+ 1
MD	3	3	NC
MF	2	1	+ 1
MI	1	1	NC
MN	0	1	— 1
MT	1	0	+ 1
NC	0	1	— 1
NE	0	1	— 1
NH	0	2	— 2
NJ	2	3	— 1
NM	2	2	NC
NY	3	2	+ 1
OK	1	1	NC
OH	6	10	— 4
OR	1	1	NC
PA	8	3	+ 5
TN	3	3	NC
TX	5	2	+ 3
UT	3	1	+ 2
VA	2	3	— 1
WA	6	2	+ 4
WI	0	1	— 1
TOTAL	106	106	

Source:

InKnowVation

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NASA SBIR Program Awards
Phase I and II: FY 83 - 84 Comparisons

	FY 83	Phase II	Follow-through %'s	FY 84	Change
Alabama	5	4	80.0%	6	+ 1
Arizona	1	1	100.0%	3	+ 2
*Arkansas	—	—	—	1	+ 1
California	24	14	58.3%	33	+ 11
Colorado	1	1	100.0%	4	+ 3
Connecticut	3	—	0.0%	3	NC
District of Columbia	1	—	0.0%	1	NC
Delaware	1	1	100.0%	0	— 1
Florida	3	—	0.0%	0	— 1
Illinois	1	—	0.0%	0	— 1
*Indiana	—	—	—	2	+ 2
Maine	1	—	0.0%	3	+ 2
Maryland	5	3	60.0%	4	— 1
Massachusetts	18	10	55.6%	15	— 3
Michigan	3	3	100.0%	1	— 2
Minnesota	1	—	0.0%	1	NC
*Nevada	—	—	—	1	+ 1
New Hampshire	—	—	—	1	+ 1
New Jersey	3	2	66.7%	4	+ 1
New Mexico	1	—	0.0%	3	+ 2
New York	5	3	60.0%	1	— 4
North Carolina	1	1	100.0%	—	— 1
Ohio	4	2	50.0%	4	NC
Oregon	1	1	100.0%	1	NC
Pennsylvania	5	5	100.0%	4	— 1
Rhode Island	1	—	0.0%	—	— 1
*Tennessee	—	—	—	2	+ 2
Texas	2	—	0.0%	10	+ 8
Utah	2	1	50.0%	—	— 2
Virginia	6	3	50.0%	12	+ 6
Washington	4	3	75.0%	3	— 1
*Wisconsin	—	—	—	2	+ 2
Totals	103	58	56.3%	129	+ 26

Transportation
FY 84 Phase I

CA	5
IL	2
CO; CT; DC; DE; MA; NJ; OH; TX; UT; VA; WA;	1 ea.
	18

EPA SBIR
Program Results

State	FY 83	FY 83 Phase II	FY 84
CA	1	—	2
CO	1	—	1
CT	1	—	0
MA	1	1	3
NC	1	1	0
NJ	0	—	1
NY	0	—	1
OH	1	1	1
OR	1	1	0
PA	1	—	0
TN	0	—	1
TX	1	—	0
WI	1	1	0
Totals	10	5	10

Nuclear Regulatory Commission
FY 84 Phase I and II Awards

	Phase I	Phase II
CA	1	2
ID	2	—
MD	1	—
TN	1	1
WA	1	1
Totals	6	4

Source:

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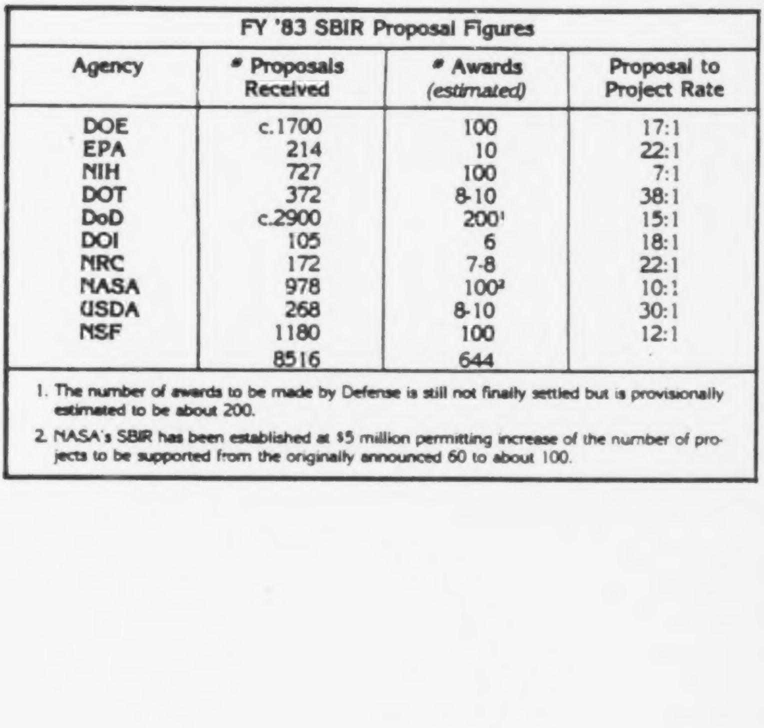
Appendix V

Figure IV



FY '83 SBIR Proposal Figures

Agency	# Proposals Received	# Awards (estimated)	Proposal to Project Rate
DOE	c.1700	100	17:1
EPA	214	10	22:1
NIH	727	100	7:1
DOT	372	8-10	38:1
DoD	c.2900	200[1]	15:1
DOI	105	6	18:1
NRC	172	7-8	22:1
NASA	978	100[2]	10:1
USDA	268	8-10	30:1
NSF	1180	100	12:1
	8516	644	

1. The number of awards to be made by Defense is still not finally settled but is provisionally estimated to be about 200.
2. NASA's SBIR has been established at $5 million permitting increase of the number of projects to be supported from the originally announced 60 to about 100.

Source:

InKnowVation, Volume I Number I

Published by:
Innovation Development Institute
Swampscott, MA 01907

Mr. MAVROULES. I suggest to my colleagues that we listen to the next witness before we address any questions.

I want to welcome Mark Levine now with Geo-Centers, Inc. Welcome back, Mark, and we await with interest your testimony.

TESTIMONY OF MARK J. LEVINE, ASSISTANT TO THE PRESIDENT, GEO-CENTERS, INC., SUITLAND, MD

Mr. LEVINE. Thank you. This is my first time on this side of the table. It is a lot easier to ask the questions than to have to answer them.

Mr. MAVROULES. Don't be too sure about that now.

Mr. LEVINE. I want to begin by congratulating you on your recent success at OMB convincing them to lift that cap. I say this personally, as well as for a lot of other small businesses, Mr. Chairman, Mr. Conte, Mr. Olin, my former boss Congressman Bedell, that this is just another example of your doggedness, your influence, and your leadership on this issue and all other small business issues. I really thank you for that. It was a very fast turnaround for OMB, and I appreciate it.

Thank you for the opportunity to testify before your subcommittee this morning. I believe that your interest in the SBID program is both timely and well advised. I am here representing my new employer, Geo-Genters, Inc., and its president and founder, Dr. Edward Marram.

Geo-Centers was founded in 1973, and we are a member of the Inc. Magazine's list of the fastest growing privately owned companies in America. We employ 130 people and have offices in Boston, Albuquerque, Washington, DC, and Dover, NJ. Our growth rate in both revenues and employment have more than doubled in the past 2 years.

We have been a successful participant in the Federal Government's Small Business Innovation Development Program. We have won several SBID phase I awards, and we have been successful in converting most of those awards, actually five, into phase II contract.

Although our SBID work is not our most significant source of revenues, we feel that this program is of tremendous importance to our company and other innovative small businesses.

Our company is currently at a very sensitive crossroad. We have demonstrated our technical and business management skills. We are now at the point where we must make hard decisions as to how best we can serve our employees, our stockholders, and our market.

In our 12-year existence, we have developed and patented some very exciting and potentially lucrative innovations. Our participation in the SBID Program has been an important factor in our attempt to chart a new course for our company.

Geo-Centers has extensive experience in the field of fiber optic sensor technology. We have developed and built prototypes of sensors that by far outperform conventional electromechanical sensors on both measurement sensitivity and cost.

In addition to being able to replace conventional industrial sensors, our sensors are immune to electromagnetic interference and can safely be used in corrosive, explosive, radioactive, and other hazardous environments. This unique ability opens up several new uses for our sensors that are extremely valuable in many areas of our society.

Let me give you a few examples of how our sensors can be used where conventional sensors cannot.

Our technology will allow the monitoring of nuclear and hazardous waste dumpsites. Our sensors can be buried around the perimeters of a dumpsite and immediately detect when waste is leaking into ground water or otherwise escaping from the site.

We are presently negotiating with a client to develop a sensor to analyze the chemical composition of fuels and other compounds in realtime to prevent environmental contamination and downtime in industrial processes.

We are developing a sensor system, which is being funded under the SBID Program, for the wing structures on military and commercial aircraft. This system will tell pilots, while in flight, whether there is too much stress on the aircraft's wings, as well as informing mechanics of the exact location of these fractures. This sensor has the potential to reduce a large part of the scheduled maintenance on military aircraft; as fighter planes are routinely broken down to physically search for possible stress fractures in their wings.

Also under the SBID Program, we have designed a system to deliver electric power to remote areas. Our experience with fiber optic materials has led us to develop a fiber pure enough to theoretically transmit laser light as far as 10,000 kilometers. The Navy is interested in this program, because it gives them a new and better way to power underwater, unmanned submarines. We feel there is also a substantial commercial need to deliver power to hard to reach areas.

I mentioned earlier that the Geo-Centers was at an important crossroads and that the SBID Program has been a big help to our company. We feel we have excellent product ideas and would like to make the transition from a strictly research and development company to one that designs systems, manufactures, and markets. This is a very expensive and timely proposition.

A company like ours has very little leverage in the financial world. Bank financing is inappropriate in our case. Venture capital for us would be a one-shot deal that could mean the end of our current system of private ownership and management.

We also have too much loyalty to our employees to trust Geo-Centers' future to outside investors at this point in our history.

Instead, the SBID Program has provided us with the capital and credibility to make this transition on our own. We are able to show potential investors progress toward a commercial prototype and give them a good idea of what we can do with their capital.

Already we have been able to use our participation in the SBID Program to interest three large companies in potential joint ventures with us. Through our negotiations, we feel that the possibility of a joint venture is in the best interest of our employees and our company's future.

The combination of our expertise and technology with a potential partner's manufacturing, marketing, and financial capabilities are just what we believe to be necessary to bring a successful product to market.

I want to close by saying that the SBID Program is exactly what our country needs to keep up in the international economy. Besides the new jobs the program generates, it helps keep us ahead of our international competitors.

The Japanese are also very interested in fiber optic sensor technology. The SBID Program has allowed Geo-Centers to stay ahead of the Japanese in this important area. Hopefully, the program will also help take this technology out of our laboratory and into the marketplace. I can almost assure you that without the SBID Program, our company would lose its edge to the Japanese. Thank you.

Mr. **Mavroules**. Mark, thank you very much for your testimony. I take it you kind of like Geo-Centers, don't you? OK. I have a couple of questions, but I am going to withhold mine to defer to my colleagues. Mr. Conte, do you have any questions that you would like to ask at this point, or I can defer to others?

Mr. **Conte**. Yes; go ahead.

Mr. **Mavroules**. Mr. Olin, do you have any questions at all?

Mr. **Olin**. Yes, I have a few. I would like to get better acquainted with how this program actually works.

Mark, if you would give me some idea of how many contracts of this nature you have obtained?

Mr. **Levine**. We have approximately eight phase I's.

Mr. **Olin**. About eight, and does that mean you get $50,000 for each of those?

Mr. **Levine**. For each one of those, right. This is over a number of years. We were original participants in the Defense Department's DESAT Program which actually predated SBID.

Mr. **Olin**. Have any of these gone to phase II?

Mr. **Levine**. We have had five go to phase II. What we try to do as a company is target our phase I's. We do not throw in the phase I's. We really review the proposals internally, pick the ones that we think are best to put our time into. I think that speaks to our success rate.

Mr. **Olin**. What was the value of the phase II's then, what range?

Mr. **Levine**. The phase II's range between $350,000 and $500,000, but that is for more than 1 year. That is over a 2-year period in most cases.

Mr. **Olin**. Could you take one of these projects which you are familiar with, perhaps the fiber optics one, and give me some idea of what process you use to evaluate your work in phase I and what kind of a phase II contract you received?

Mr. **Levine**. I will take one on advanced sensor development.

We had been doing some work with fiber optic materials. We felt there was a potential to further look into the development of a sensor. We put a proposal into the Defense Department. It was reviewed by their peer review groups. They also agreed that there was potential to develop this program further.

We then were able to take a couple of our key people, put them fulltime on this project for 6 months. This is in the report phase right now, we put them on a report phase to figure out an exact research plan, chart out what we would have to do to explore the possibility of actually building a prototype and proving that such a sensor can be developed.

Mr. OLIN. What is this sensor sensing?

Mr. LEVINE. It can sense anything from pressure, temperature flow, electric current. It has a diverse range.

Mr. OLIN. Is it used on aircraft?

Mr. LEVINE. The one on the aircraft is right now on phase I. That is another good example.

Mr. OLIN. Let's stick with the other one.

Mr. LEVINE. When we finished with phase I after 6 months, we then submitted the results of our feasibility study, and, in fact, if we did not think we could do it, we would not have bid into phase II.

We felt it was pretty good, and we submitted the phase II, and it was selected as a winner.

Mr. OLIN. What is the objective of phase II then?

Mr. LEVINE. To develop a prototype of a commercial product.

Mr. OLIN. And how much time are they giving you to do that?

Mr. LEVINE. We have 2 years on the project.

Mr. OLIN. And you are probably through that?

Mr. LEVINE. Partway through it. Already, as a condition of getting a phase II, we had to find another outside source that would assist us in the development. Obviously, for $500,000 we are not going to get a product like this to market, but we were able to interest another large concern, and right now, we are talking about a possible joint venture.

Mr. OLIN. OK. Thank you, that gives me a good idea what the project entails. I wonder if I could ask Ann a couple of questions.

Do you know how the large research organizations specifically industries and universities, feel about this program?

Ms. ESKESEN. The university community, as you know, was a prime source of the opposition, and it tended to be the university administrator as opposed to the university researcher. That opposition has been mitigated substantially in the last 2 years, primarily, I think, because there is a fairly active participation of the university community in the phase I and phase II projects as consultants to those firms.

One of the primary recommendations to companies which are less experienced in the research effort and many of the companies currently involved are not from an academic research background and haven't that type of experience, and there are some skills which go with that which are very effectively brought into the company by consulting arrangements, in addition to which it is one of the most effective ways to insure that you are maintaining that leading edge focus by working with those who are publishing on that leading edge.

So that opposition has been somewhat mitigated. In the larger organizations, what we are finding is a phenomenon of spinoff being used, that is, SBID is being used by individuals within other institutions with ideas that are not particularly in the center of the interest of their current employers and are, in fact, spinning out of that institution using SBID as a means of opening the company's door.

There does not seem to be any opposition or rivalry, quite the reverse. I think there is a feeling that this is a population who are well qualified to do the job and, in fact, give them a fair crack. That is not to say that in conditions where there was a considerable decline in the availability of research dollars that that competition would get hostile, but at the moment, it does not seem to be so.

Mr. OLIN. Do you know how the agencies feel at this point? Is everybody satisfied with the investments they are making? Do they feel they are getting their money's worth?

Ms. ESKESEN. I would like to go on record as saying that I have been extraordinarily impressed by the caliber and the commitment of the agency people. There has been a selection of staff people for the administration of this program which has been extraordinarily well done.

The level of support that is being provided by those people to active participants in this program is commented on all over the country. There are problems. There is no question that there are certain special areas, special content, and I referenced one of them in my written testimony where there needs to be some fine tuning of the program.

But, on the whole, I think the agencies, some of which were initially apprehensive, are in fact now very positive and are receiving some high quality work done for the money and don't at all feel that——

Mr. OLIN. You mentioned a big dropoff from phase I to phase II. The table seems to indicate that maybe around——

Ms. ESKESEN. It is about 47 percent.

Mr. OLIN. Thirty percent survive, at least on this chart.

Ms. ESKESEN. It is an interesting phenomenon. Of course, phase I by definition is a high risk effort, and there are going to be a percentage of companies whose projects simply do not pan out.

There was also a percentage of projects where the money was sufficient for the companies to continue it elsewhere or that the project advance sufficiently. So that the conversion rate in the agencies from phase I to phase II seems to run between 30 and 40 percent. That number, however, is a little misleading, because the actual application process involves a lesser number than the original phase I group.

So for those who apply in, the selection process at phase II is a very favorable 60 to 70 percent.

Mr. OLIN. I do not think that is too surprising that you have quite a dropoff.

Mr. LEVINE. You also have a lot of Federal Agencies that pick up phase I's with their regular program funds.

Mr. OLIN. I also noticed on your chart here that Virginia stacks up pretty well.

Ms. ESKESEN. They are coming up fast.

Mr. OLIN. No. 3, I think that is great and encouraging. No doubt Massachusetts is going to have a little trouble.

Ms. ESKESEN. Give them a run for the money.

Mr. OLIN. Is there any way of assessing the administrative costs of this program?

Ms. ESKESEN. I do not have it.

Mr. **Olin**. Since the work is spread around on these projects, I would assume the administrative work is also spread around. Is this true?

Ms. **Eskesen**. It is. In the five major agencies with the larger programs, there are staff assignments that are specific to the SBID effort. In the other seven smaller agencies, it is an assignment to SBID over and above the regular activities of a particular staff director.

Mr. **Olin**. Mr. Chairman, I would like to make one observation. From my experience with technical work in industry, I think Ann is right. It is going to take 6 or 7 years to see your accomplishments. It will take that long to develop a product that has any kind of continuity. Small businesses will certainly be enamored with this program I think it will be necessary to keep an eye on the activity of this program, so that at the end of 6 or 7 years we can point with pride to some real achievements.

Ms. **Eskesen**. I think you are going to see some of that evidenced today, but I think it is also interesting, today we have all small business people testifying.

Last Friday, I had lunch with two or three large business people who are indicating very high levels of interest, 3M Corp. has already extensive involvement. Combustion Engineering has an equity involvement in two SBID companies, almost specifically because of the high level of technical competence that the SBID Program provided these companies, and there are several others.

Mr. **Olin**. Thank you, Mr. Chairman. I hope I did not take too much time.

Mr. **Mavroules**. No, you did very well, Jim, and thank you for the questions. They were very thoughtful. I just want to assure you and the other members that we will continue the oversight on this particular problem, and perhaps somewhere down the line if we have enough time, we will have some field trips on this throughout the country so we can get a better understanding of how people feel throughout the country.

At this point, I would ask Mr. Sisisky if he has any questions?

Mr. **Sisisky**. Thank you, Mr. Chairman. I apologize for being late to the panel members. I had to go to another meeting, as we all have to do around here. I would ask unanimous consent to submit a statement to be placed in the record. I welcome panel experts, especially the former staff person for this committee. I have no questions—I'll give him a free ride.

Mr. **Mavroules**. Without objection, your opening statement will be included in the record.

Mr. **Sisisky**. Thank you, Mr. Chairman.

Opening Statement of Hon. Norman Sisisky, a Representative in Congress From the State of Virginia

I am pleased to be here today to participate in a discussion of the Small Business Innovative Research Program. I must admit it's always a pleasure to hear about one of the more successful programs Congress has mandated.

I understand when this program was developed, many of the agencies required to participate were extremely skeptical of the merits of this activity.

However, since the program has been in existence, two of the agencies which did not support the concept in the beginning are now funding the activities at levels that are higher than required by law. (DOD and NASA.) I further understand that the 8,000 proposals submitted last year were of extremely high quality. One agency [DOE] even found other in-house programs to fund some of the better ideas that were not awarded SBIR grants.

Actually, I'm just as happy I don't have to choose the winning proposals. I bet it's a tough job!

It's clear small businesses are the most prolific innovators. Statistics tell me that small businesses develop 2½ more innovations than large business. (These statistics come from the patent office.) Some of the more notable examples are: The transistor; helicopter; xerography; sewing machines; ball point pens; air conditioners; penicillin; and vaccine for polio. These products are all the children of small business—who have grown "BIG."

Of course this means . . . jobs . . . taxes . . . I'm a little embarrassed. I'm beginning to sound like an advertisement!

I can appreciate how difficult it is for many of these small companies to take an idea and bring it to a marketable state. I have to admit the public/private aspect to the SBID program is one of the more practical solutions to a very difficult problem . . . And I like it.

Another aspect of this program I find healthy is the public acceptance of the program. The attendance at the First National Science Foundation Conference in 1974 was attended by a mere 200 people. More recent conferences have drawn 700 to 800 people. The three conferences in 1986 are expected to draw at least 1,000 for each conference.

In short, there is much in this program that can be praised. And I am pleased to be here today to support this concept.

Mr. **Mavroules**. Mr. Conte?

Mr. **Conte**. I want to compliment both Ann and Mark for their testimony here today. It was excellent.

Ms. **Eskesen**. Thank you.

Mr. **Conte**. As one who strongly supported this legislation, I am really pleased to hear it is bearing fruit. Mark, good to see you. What happened to the other guy?

Mr. **Levine**. He got up a lot faster than I did.

Mr. **Conte**. We had the pleasure of working with Mark when he was here with Berkley Bedell, and we had a wonderful association, not only with you, but with Berk, and I am going to miss you.

Both of you have testified to the benefits of the SBID Program, but you also, I think, deserve a great deal of credit since it was your innovation and your research that made the grant possible.

Mark, you mentioned that the SBID Program has resulted in increased employment in your firm.

Mr. **Levine**. A little bit now, and we hope a lot more in the future.

Mr. **Conte**. How about you, Ann?

Ms. **Eskesen**. There does seem to be evidence of a doubling of employees as a result of SBID involvement, but I caution that we should not be looking at only the impact on the firm in terms of size of employment, because I think more important is going to be, did the innovation make it to market by whatever means.

The evidence seems to be that for every one technical job which is created there is a spinoff service support structure of anything up to six or seven jobs. I think we will need to be factoring that into the calculations when we look at the overall employment impact.

Mr. **Conte**. Do you think you would have developed the ideas or the innovations on your own had you not had this program?

Mr. **Levine**. That is difficult to say. We did initially look at venture capital and taking the company public to do it. However, we felt we were in a pretty good leverage situation with venture capitalists, but you never really are.

I think we could have gotten enough money to take the company through the first phase of development, and then would have had to go back for second phase equity, and by that time, we might have lost control of the company, and that just was not worth the tradeoff for us.

Ms. **Eskesen**. The commonest report that we hear from companies involved in SBID is that it is enabling them to put a strong anchor in their available technology, that which they have under development. More commonly in the slightly more mature firm, it is the means whereby to insure the continued survival and operations of the firms.

Not very long ago, you looked at a product life cycle in decades. You now look at it in years, and we have lots of front page news of stories and companies who had a superb first product and then fell flat on their face when the second generation of products was not there.

SBID is providing an opportunity for many small firms to work from their existing base into that next generation of activity which will enable them to survive.

Mr. **Conte**. You know, I am sure you are familiar with the study by Gellman Associates. They say, on the average, small firms produce 2.5 times more innovation per employee than larger firms and commercialize those innovations 1 year faster at 25 percent of the cost. I imagine you would find Gellman's report quite accurate.

Ms. **Eskesen**. I would say so. You are pretty hungry, and you have got to be fleet of foot, because until those sales revenues begin to flow, who meets payroll for you? I mean, in this case necessity is the mother of invention.

Mr. **Conte**. I tell you, you have got to be fleet of foot around here to survive.

Mr. **Levine**. You ought to put in for a phase I.

Mr. **Conte**. Let me say that if either one of you have any expansion plans, come up to the Berkshires. We really have some beautiful towns up there, great water, good schools, good scenery, and a lot of unemployed people.

Mr. **Mavroules**. Sil, you are too late. I have already made that pitch.

Mr. **Conte**. Do you think that the SBID Program has lived up to your expectations, either one of you? How responsive have the Federal Agencies that you are involved with been to the leads and the ideas that your industry came forth with?

Had your firm ever done business with the Federal Government before? You say yes, Mark, before the Innovation Act.

Mr. **Levine**. We have and the response to the program by the Federal Agencies at the program level has really been tremendous. Our experience is with the Department of Defense, the DESAT Program, and SBID. The personnel they have working on the DOD Program are topflight. Their solicitation booklets are very good. The competition is great over there. The new ideas that come out really prove the program is working very well at DOD.

Ms. **Eskesen**. And we are finding consistently reported that number of companies—let me backspace a minute. We found in the first year in the program there were quite a lot of companies involved who brought from their previous career experience their proposal writing skills into successful participation in the phase I effort.

Now, we are seeing more and more companies coming in who are more problem oriented, and usually engineering focused than the physical science focus of previous years.

These companies had a tough time learning how to initially become involved in this process, but having learned, they have learned very well and are extremely effective now in their phase I and phase II conversion efforts.

Mr. **CONTE**. In 1981, I am sure you know, the Congress passed the research and development tax credit which provides benefits to firms that heavily invest in research and ideas. Some have called the R&D tax credit the investment tax credit for ideas.

Is the R&D credit complementing your research with the SBID Program as well, and have you been able to take advantage of that tax credit, either one of you? Do you support its extension beyond this year's expiration date?

Mr. **LEVINE**. We would support its extension. We have not used it as much as other companies might because we do not internally generate funds for R&D to the extent that we can use the credit.

Also, for most small companies, you have to be earning money to take a tax credit, and it is a little bit beyond us. However, I must say that we are not personally involved in the situation, but I do know situations where larger companies with the opportunity to take a tax credit are using the credit to fund development and innovation in small companies. So, indirectly, it has had a very significant impact.

Ms. **ESKESEN**. I would concur with that. I find as a general rule the companies indicate that they're not currently using for exactly the reasons that Mark articulates. It does require a base of operations of several years, and you do have to be in an income generating activity to do it. But, the potential is there, and the climate that is created that is supportive of the research effort is as important to the specifics. R&D tax credit most certainly contributes into that climate creation.

Mr. **CONTE**. Thank you, Mr. Chairman.

Mr. **MAVROULES**. Thank you very much, Mr. Conte. I have a question for each of you. I am going to ask that your response be limited, because we have certain time constraints today. I also have a number of questions that I am going to ask staff to send to you. Please respond to those, and we will make it a part of the overall record.

The first question I have is for you, Mark. It is my understanding that the program is working quite well in the Defense Department. What are your impressions about that? Everything I have heard is that they are doing a very good job.

Mr. **LEVINE**. I think the enthusiasm by the people who run the programs in the various services is very, very high, and I only have great things to say about the way they operate the program, the professionalism and competence they show in doing so.

They took the program on themselves even before we passed the law.

Mr. **Mavroules**. Very good. What we are going to do Mark, is to send you some additional questions to elaborate upon.

Ann, I have a question for you. You know, my office has been contacted by representatives from Great Britain who are interested in developing their own SBID Program. Have you had any experiences with that?

Ms. **Eskesen**. Yes; in fact, a couple of weeks ago I was called by Roland Tibbetts from the National Science Foundation and asked to escort around someone from the British Department of Trade and Industry.

I spent 2 days with that gentleman—it worked wonders for the resuscitation of my accent—but what we did over those 2 days was arrange for him to meet with groups of active SBID companies in the Massachusetts area.

It was a very successful effort for them and also for him, and it was interesting to watch the maturing of his perceptions of what the British are going to do from an initial concept of is this a good idea, maybe to how exactly are we going to do it and when are you available to help us.

I think it is almost certain that the British will put something of this type into effect in the relatively near future and also the Dutch. Those types of opportunities open doors for companies in this country to access into that European market which in several industries is very important, in the pharmaceutical industry, for example.

You can bring a new product into market far more rapidly in Europe than you can here, so those types of complementary programs have a very important effect on the availability of opportunities.

Mr. **Levine**. I got a call from The Hague yesterday, and they are sending somebody over to discuss the program.

Mr. **Mavroules**. I just want to thank both of you. My predecessor has just arrived. Berkley, do you care to make any statement?

Mr. **Bedell**. Mark has already had experience with me on the Small Business Subcommittee. I think I should publicly state how much I appreciate the work that he did with us when he was on committee staff. It was just a tremendous privilege to serve with you, Mark, and I think you contributed a tremendous amount to small business and to the work of the Congress.

Mr. **Mavroules**. Thank you very much, Berkley, and let me thank both of you for being outstanding witnesses this morning, very interesting and very informative. Thank you very much.

We will now call the next panel. The next panel is Dr. Harold Lonsdale who is president of Bend Research from Bend, OR; Joseph Lahoud, Greenbriar Systems, Inc., from Vienna, VA; John Stetson, PDA Engineering, Inc., Santa Ana, CA; and Dr. Fritz Bien, president, Spectral Sciences, Burlington, MA.

Welcome, gentlemen. Perhaps I can advise you to capsulize your opening statements. We will include all of your statements for the record, of course.

The first witness will be Dr. Lonsdale.

TESTIMONY OF HAROLD K. LONSDALE, PRESIDENT, BEND RESEARCH, INC., BEND, OR

Mr. **Lonsdale**. Mr. Chairman, members of the subcommittee, it's a distinct privilege for me to be here. I just want to make certain that it is not perceived as an entirely Virginia and Massachusetts show. I am from the State of Oregon where we have also discovered the SBIR Program.

There are five things I want to cover. I have been allowed 5 minutes. That is about a minute per subject, so I want to move along fairly quickly. I have written a prepared statement which I have submitted to the subcommittee.

Mr. **Mavroules**. Very good. All of your prepared statement will be included in the record.

[Mr. Lonsdale's prepared statement follows:]

Prepared Statement of Harold K. Lonsdale, President, Bend Research, Inc., Bend, OR

There are four topics I would like to address today. First, I'd like to tell you just a bit about our firm, Bend Research, Inc. Second, I will comment on the Small Business Innovation Research (SBIR) program, from our perspective. Then, I will turn to the needs of the entrepreneur for capital, the difficulties we have experienced, and the success we have realized through the SBIR program. Finally, I will address the bigger picture of international competition and the need for leadership and courage here in Washington, D.C.

ABOUT BEND RESEARCH

Our firm was founded in 1975, as an R&D company. Together with our two affiliated companies, we now employ about 70 people. We specialize in membrane science and technology. Membranes can be considered very fine filters, and they are now used in such diverse applications as water desalination, pollution control, artificial kidneys, and slow-release drugs. The worldwide market for membrane-based products is now about one billion dollars annually. The U.S. is clearly the leader in this technology, although Japan has targeted membranes as a high growth area, and they are now outspending the U.S. in R&D by at least three to one.

Let me give you one concrete example of membrane technology. About 2 billion gallons of brackish water and seawater are desalted each day around the world. That's enough water to supply all of Los Angeles, for example. About one-third of that water is now desalted by a membrane process called reverse osmosis, which is less energy-intensive and cheaper overall than the age-old technology, distillation. The U.S. supplies about 70% of the reverse osmosis capacity in the world and our principal market is the water-short Middle East. Our company will soon be marketing a reverse osmosis product.

THE SBIR PROGRAM

I have described the SBIR program as the finest to emerge from the federal government in the history of government-sponsored R&D. It is now widely recognized that the majority of innovative ideas in our country come from small entrepreneurial companies and individual inventors. The SBIR program sets aside a very small portion of the R&D budget of each of the eleven largest R&D-funding agencies of the Government and targets those funds for the support of innovative, product-directed ideas in small companies. Prior to SBIR, those small firms received an extremely small portion of federal R&D funds, and, with the increased costs of progressively more sophisticated R&D, it was difficult for small firms to carry on competitive development programs.

The SBIR program is changing all that. Competition for the awards is keen, as it should be. Only about one proposal in ten is funded, nationwide. The response by our nation's small firms has been overwhelming—more than 10,000 ideas for new products and processes have been submitted already, after only two-plus years of the program. And the National Science Foundation has shown that Government funds have been highly leveraged with private-sector funds, once the ideas have been shown to be technically and economically feasible.

Our firm has been awarded 15 Phase I contracts, 7 of which have now advanced to Phase II. The awards have come from seven agencies: DOD, DOE, Interior, EPA, NASA, NIH, and NSF, so we have developed a fairly good appraisal of the SBIR programs in the various agencies. We feel that the programs at NSF and DOE are probably the best administered. Only at HHS/NIH have we encountered resistance to the program, and that stems almost entirely from certain ill-considered and outdated language in the annual HHS appropriation law.* As with the other winners, it is too soon to judge the magnitude of the success of these developments in our firm, but the early results—described below—are encouraging.

Let me add these further thoughts about SBIR:

1. In a sense, the program can be considered "free" to the U.S. Treasury. The funds are simply taken out of existing agency R&D budgets. In addition, the funds are quite small relative to the total U.S. R&D budget: SBIR represents less than 1% of that budget.

2. A hidden benefit of the SBIR program, from our point of view, is that it has required each agency to come up with a list of its objectives. The solicitations amount to a detailed mission statement by each agency which, in many cases, did not previously exist. We think of these solicitation documents as "shopping lists," and those lists lighten our burden of determining, by implication, what the U.S. and world economies want and need.

3. Most major U.S. companies are now watching the SBIR program very closely to look for new products and processes related to their existing businesses. We have found these

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*I refer here to Section 202 of P.L. 98-619, which should be changed.

companies coming to us, sparing us the need to find them, and this "brokering" function of the SBIR program is also important to U.S. economic growth.

4. We already see evidence that SBIR is being judged with a very short time-constant. Modern R&D is a slow, expensive, low-probability business. The odds are so low and the current cost of money is so high that many U.S. chemical companies, for example, have cut back drastically on their R&D programs. (Instead, they are busy with acquisitions and mergers, which contribute nothing to our national economy.) We hear so frequently about the rapid success of a tiny handful of companies like Apple Computer that we tend to overlook the very slow growth of most of our new, hitech products. It now takes about 8 years—and many millions of dollars—to introduce a new drug product in the U.S. While only one SBIR proposal in ten is successful in terms of an R&D contract, probably only one in a hundred will turn out to be a significant commercial success. So I ask the Congress, OMB, and the other powers here in Washington not to judge the SBIR program prematurely, but to be patient and have faith in the American innovation system.

Let me repeat that the SBIR program, in my opinion, is the best to ever come out of the federal R&D procurement process, and I believe it is destined to have the most favorable impact on the U.S. economy.*

CAPITAL NEEDS AND CAPITAL SOURCES

All new hitech products and processes need substantial amounts of capital before they can be successfully developed, manufactured, and marketed. Beginning about two years ago, our firm had completed the R&D on several innovative products that we felt were ready for commercialization. We needed about $3 million for the introduction of our first products. That's when we discovered that, in spite of all the talk about abundant venture capital, the sources of capital available to us were few and the terms were generally repugnant. We explored venture capital sources and found that, while they have abundant capital, they fund only about one deal in one hundred (1) and that they generally want takeover rights if the company in which they are investing falters. Most onerous, they are looking for very high returns on their investment—typically tenfold in 5 years. But what about companies and new products, like our own, that are winners but just don't have that high an expected return on investment? What about the vast middle ground of the American innovation system?

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*It is largely the brainchild of Roland Tibbetts of the National Science Foundation. If anyone within earshot knows of a medal for outstanding Government service, please bestow it on him.

We considered "going public" but decided that our growth rate might not satisfy the expectations of private investors. We've seen too many companies sell their stock at $10 per share and then have it fall to $2 per share to want to join into that game.

In the end, the Bethlehem Steel Co. invested the $3 million in a new company we set up to commercialize some of our products: Consep Membranes, Inc. What attracted Bethlehem were two of our technologies, one of which can be applied to the cleanup and reuse of chromium wastes in the steel industry, and the other to the cleanup of waste streams produced in enhanced oil recovery. Both of these new technologies were developed, in part, through the SBIR program.

We also have established a joint venture with the W.R. Grace Co. in which they have made a sizable investment. As an adjunct to that new business, the Grace Co. is endorsing one of our SBIR Phase II programs, and plans to commercialize the product if the development work continues to be successful.

So the SBIR program has already worked for us, and promises to work even better in the future. Under the program, we are at work on these new technologies:

- a process to extract oxygen from air, that promises to cut the costs of this important chemical and extend its uses.
- a method to clean up heavy metal pollutants from sludges produced in the plating industry.
- a method to recycle washwater, urine, and other waters in the space station.
- a method to clean up stack gases from power plants and thereby eliminate "acid rain."
- a method for extracting drinking water from vehicle exhausts that could be used by the military, for example, in remote areas.

INTERNATIONAL COMPETITION

I appreciate the opportunity to make this testimony in support of the SBIR program. However, I cannot let the following thoughts go unsaid.

For twenty years after World War II, our country had no serious competitors for our new hitech products, and we experienced an era of unparalleled growth and prosperity. Those days are gone, probably forever. The Japanese and others are pressing us hard in international economic competition. The SBIR program is a good one but it is not enough. In addition:

(1) We need to be able to manufacture our newly developed products at a competitive price, because we no longer have the technology and know-how exclusively to ourselves. Because of the Freedom of Information Act, our company's reports on our Government contracts are now probably read first and more seriously in Tsukuba, Japan, than they are in New York or San Francisco*.

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*I consider the FOIA too liberal, and feel that we should take steps to better protect technologies developed with public funds.

(2) We also need to have foreign markets open to our products. Foreign, especially Japanese, protectionism is only part of the problem. The strength of the dollar, caused by our high interest rates, caused in turn by our huge deficits, greatly limits the competitiveness of U.S. products overseas.

Good ideas and good products simply aren't enough anymore, and this is clearly no time for laissez-faire capitalism.

What we need is courage among our elected officials here in Washington. We need to balance the budget by raising taxes, or reducing spending, or both; cut interest rates; and allow the dollar to weaken so that we can increase exports and reduce imports. Americans have lost faith in their elected representatives because those representatives do not have the courage to stop deficit spending and put America's economic house back in order. The American worker, the American businessman, and the American inventor are all doing their jobs well. We ask America's Congressmen o do the same!

Mr. LONSDALE. The five things I want to cover briefly are the company, Bend Research, Inc., located in Bend, OR; some comments about the SBID Program, as we see it; the difficulties of raising money in the United States of America today; a word about courage; and a word about the National Innovation Network.

Those are my five topics. Let me begin. Our company, Bend Research, is now about 10 years old. We began in 1975. Bend Research and our affiliated companies now employ about 70 people. Our company, Bend Research, is strictly an R&D company, and we work in the area of membrane technology.

I hold here a membrane separation module. Membranes can be considered extremely fine filters. This filter can desalt water or separate oxygen from air, for instance. These are sort of molecular filters. That is what we do, and that is what we have been doing for the last 10 years. We consider ourselves very good in that field—experts in that field, in fact.

Let me then turn to the SBID Program, if I could. This is the finest R&D-encouraging program to come out of the Federal Government in the 20 or so years I have been dealing with the Federal Government. In a sense, the program is free. I suppose there is nothing completely free, but it does set aside a percentage of the existing Federal agencies' R&D budgets, so in that sense, it is free.

Our company has been one of the major winners of SBID awards—something like 22 awards. We have won 14 phase I awards, 8 phase II awards, and we have dealt with most of the Government agencies: DOD, DOE, NASA, DOI, NIH, EPA, and the National Science Foundation, so we have some overview of what the programs are like.

I might say by way of bottom line that the SBID Program clearly brought money to our firm; I will talk about money raising in the next segment of my comments. Perhaps an unrecognized, or poorly recognized, aspect of the SBID Program is the brokering function it serves; it brings big companies like the big chemical companies with whom we deal and small research-oriented companies like ourselves into contact. This important brokering function that I think was not recognized in the early stage of the program is the so-called phase III work.

I would also like to say by way of opening comments about SBID that it is very early in the program. The program really began officially, as you know, in early 1983. It is less than 2½ years old. It has already been stated here that it takes several years to develop new products.

We hear a lot about the new high-tech companies—the Apple computers, Spectraphysics and so on. There are very few of those in this country. There are many, many companies like our own—like those represented on this panel and on other panels you will hear from today—that are not super sexy, that do not attract large quantities of venture capital in the early stages of their development, as we have not, but, I think, still represent the backbone of new high-tech American technology.

Some of the things we have worked on and are to work on in the SBID Program include some aspects of pollution control. These membrane filters can be used to control a variety of pollution problems in our country and around the world. We are working on under the SBID Program, a development for the extraction of oxygen from air—oxygen is an important chemical—the removal of acid rain from stack gases all across our country; the purification of natural gas, which is an important product in the American Southwest. Much of the natural gas produced in the Southwest has acid gas constituents in it. We are developing a process under SBID for removing those constituents from natural gas, for the purification of coal-gasification products, for coal conversion to gas applications, and even for the recovery of water and the recycle of water in the space station. So, we are very broadly locked into the SBID program.

We have a number of good developments coming along. As I said, there are few Apple computers. There is the vast middle ground, and in that middle ground it takes several years to develop new products. So, I would ask the panel to not judge SBID too early. It may take until 1988 or 1989 before SBID is a big success.

I can give you our own success story. Because of our visibility in SBID, and, in fact, specifically because of a program we developed initially under NSF funding, before SBID existed, under the so-called ASRA Program beginning in 1977, we developed a pollution control process for recovering chrome and other wastes from solution. The Bethlehem Steel Corp. heard about it about a year ago. The process is now fully developed. We were out looking for money—about $3 million—to develop that and other processes, and Bethlehem Steel funded a new company that we have started called Consep—an affiliated company of our own—to the tune of $3 million.

They, specifically, wanted marketing rights for the chrome-recovery technology, which we granted them as a part of our arrangement with them.

Moving on to the subject of money raising in the United States, a lot has been said about the availability of venture capital, and it is true. There is an enormous amount of venture capital out there. It is capital that is extremely hard to come by.

The terms we find very onerous, bordering on repugnant. In fact, although we searched the venture capital field for 2 or 3 years, we finally abandoned venture capital. We find them even greedier than we are, I might add.

We looked at going public. That did not seem to be quite to our liking either. We finally turned to corporate investments. We have attracted two major companies—the W.R. Grace Co. of Maryland and the Bethlehem Steel Co. of Pennsylvania—to make investments in spinoff companies of Bend Research. We find corporate investment is a very effective method for raising money and getting our products on the market place.

I want to speak briefly on the subject of courage, if I could. It is far removed from the subject of this hearing, gentlemen, but I have come a long way, and we in Oregon are experiencing an extremely depressed economy.

In my county, the unemployment rate officially is more than 15 percent. Unofficially, it is close to 20 percent. The SBID Program is important, but it is not sufficient, I think, for what we need to improve the economy in this country. We have got to be able to sell our products overseas at competitive prices. We have to be able to sell our products within the United States at competitive prices. I think to do that, we have to do three things: We have to soften the dollar; we have to balance the budget; and we have to reduce interest rates. I do not vote on the things you vote on, but I ask you from the bottom of my heart to have the courage to balance the budget in this country so, in fact, we can reduce interest rates and weaken the dollar, so that we can export things to our economic competitors. We do not have a lock, as we once had, on technology in the world.

Mr. **Mavroules**. Have you talked to President Reagan at all?

Mr. **Lonsdale**. If he would see me, I would be glad to. I would say, "show courage. We must balance the budget. It is No. 1 on my list. Whether we do that by reducing spending or raising taxes, I do not care, but I would ask you to somehow balance the budget."

The final comment on my list: I represent something called the National Innovation Network. This is the brain child of a man named Milton Stewart, whom I believe all of you know and some of you must know well.

In Oregon, we have started a spinoff of the National Innovation Network called the Oregon Innovation Network, the first result of which is something I hold here, called the Oregon Entrepreneurs' Handbook. It has only been out a week. We hope to sell a number of these around our State. This handbook is a soup-to-nuts recipe, really, for starting one's own company, high-tech or otherwise. It addresses preparing the business plan; raising money—the hardest part of our business, of course, is raising money; attracting good people; keeping them there; doing marketing of your products; using the media; and, of course, the SBID program, which we consider very important in our State and around the country.

The objectives of the National Innovation Network are to encourage entrepreneurship across the United States—particularly in the small companies that do the most innovating; to enhance university/industry collaboration, which we are doing very strongly in my own company and in our State; to encourage small-company/big-company partnerships, which we are also into; and somehow to see if we can't do something to improve the supply of capital in the United States, which we consider crucial to our own growth.

Those are my comments. Thank you for your time.

Mr. **Mavroules**. Thank you. We have some questions, but I would suggest perhaps we hold the questions through until we hear the entire panel.

I just want to respond to one thing, and that is the point that you make about courage. I think you are absolutely correct, and I appreciate your comments on the subject of balanced budgets and priorities.

I want to assure you that all Members of Congress certainly want to achieve the same goal to reduce the deficits. We have different priorities, however, from others in the executive branch, not that we will not try to work together in a bipartisan effort. I can guarantee we are going to try.

But, there are certain priorities that we find most important to our people in this country. I just want to assure you that the goals are the same, and one day we will be working together to achieve the goals that you have suggested.

Mr. **Lonsdale**. Thank you.

Mr. **Mavroules**. Our next witness, Joseph Lahoud. Mr. Lahoud?

TESTIMONY OF JOSEPH A. LAHOUD, PRESIDENT, GREENBRIAR SYSTEMS, INC., VIENNA, VA

Mr. **Lahoud**. Thank you, Mr. Mavroules, and members of the subcommittee. I am very appreciative of the invitation to be here today on behalf of myself, and also on behalf of the cofounder of Greenbriar Systems, Mr. Dixon Cleveland, who is also here today.

Greenbriar Systems is a very small company, perhaps smaller than many that you will hear from today. Greenbriar has been in business 4 years. We have four full-time people, and two part-time people. To give you some idea of the importance we place on this testimony here today and being present at this hearing, for the first time in 4 years, Dixon and I have decided to be gone from the office both at the same time.

The SBID Program has been extremely important to Greenbriar for all of the reasons which you have already heard today. I have submitted written testimony, so I am not going to repeat the things that are there, and I also do not want to dwell on the things that you have also heard very well already this morning.

What I would like to do in the few minutes that I have is just be very specific about Greenbriar since we are very small. I think I can give you a viewpoint from a small, young company, what does SBID mean to us, and what do I see in the future as a consequence of SBID.

We also found ourselves, when we first formed the company, to have grossly oversimplified the process of finding money to support the research ideas that we had when we formed the company. SBID gave us an opportunity to have our ideas objectively reviewed, and fortunately we were successful in several cases.

We won three phase I awards and two of those phase I awards have gone on into phase II. We are about halfway through one of our phase II efforts, and we are at the very beginning stages of our second phase II effort.

There are three agencies involved. The National Science Foundation awarded us a phase I. The Department of Energy awarded us a phase I which is now in phase II. The Department of Defense, specifically the Army, has awarded us phase I, and we are in the process of beginning an effort for phase II for the Army.

The work that we do, to use some simple terminology, is to computerize decision aids, custom software for very specific applications that have a variety of purposes. The work that was done for the National Science Foundation involves automobile manufacturing productivity, specifically a computerized way to tell the difference between good and bad spot welds on automobiles.

The Department of Energy work involves a computerized instrument for use in nuclear powerplant inspection processes, a way to not only speed up the inspection process, but make the very critical inspection of nuclear powerplants more reliable and more accurate than it is today.

The third area for the Department of Defense involves the development of an expert system with battle management type applications. The important thing about SBID to Greenbriar is that it has not only given us revenue to do these things and to get some of our ideas farther along than we would ever be able to do it otherwise, but it has given us that credibility that Ann talked about. I want to stress that point very, very strongly, the credibility that comes to a small company that has the achievement of SBID and the types of research results that we have achieved. It gives us opportunities now for non-SBID sources of funding which we found almost impossible to obtain before SBID.

So the future for Greenbriar is not just SBID. It is continuation in SBID. We will continue to submit proposals for phase I. We will continue to stress the transition of our phase II work into phase III, but now we have the credibility and the imagination and the experience to go and find other sources of funding and have the confidence that we can get those sources of funding because of the SBID experience.

The final thing I just want to say a few words about is the network that has already been referred to. I feel so strongly, Dixon and I both at Greenbriar, feel so strongly about the SBID Program that we do want to devote some of our time and have been devoting some of our time to encouraging other people to participate in the SBID Program.

In the State of Virginia, we have formed a network. We are proud in Virginia to be the first State to become part of Milt Stewart's National Innovation Network. We are continuing that work, and the whole idea is to bring together the network of small high tech companies for SBID purposes, but then, of course, for all other purposes.

That is the extent of my spoken remarks.

Mr. Mavroules. Very nice, and thank you very much for your testimony. I must ask you a question. Did you ever play baseball?

Mr. Lahoud. No, but I know who you are referring to. We are apparently no relation. My brother sought him out, and they had a nice conversation, but no relation.

Mr. Mavroules. Thanks a lot for your testimony and your written statement will be included in the record.

[Mr. Lahoud's prepared statement, with attachments, follows:]

PREPARED STATEMENT OF JOSEPH A. LAHOUD, PRESIDENT, GREENBRIAR SYSTEMS, INC.

Greenbriar Systems, Inc. is a small high technology company specializing in the application of signal processing and mathematical modeling techniques to a wide variety of scientific and engineering problems. Since our founding in early 1981 we have been fortunate to be involved in several applied research projects as a result of a series of contracts awarded through the Federal Small Business Innovation Research Program (SBIR).

A typical and crucial problem faced by high technology companies involved in innovative research, is the extreme difficulty associated with finding the high risk or "seed" funding required to perform initial feasibility studies. The SBIR program is evolving into one of the most important sources of this seed money in the U.S. Greenbriar to date has received a total of three Phase I awards and two Phase II awards in the SBIR Program. The agencies that have awarded contracts to Greenbriar are the National Science Foundation, the Department of Energy and the U.S. Army Electronics Research and Development Command. Continued participation in the SBIR program, including submittal of Phase I proposals and the transition of Phase II projects into Phase III, is a very important part of our long range business plan.

The early successes of Greenbriar's SBIR work are resulting in other non-SBIR related business opportunities. For example, Greenbriar is receiving considerable attention from several DOD organizations as a direct result of our SBIR work for ERADCOM. Following Phase I we were invited by the Joint Chiefs of Staff to submit a summary of our work to be considered as part of the program for the fourth annual DOD/C3CM conference in February 1985. Greenbriar was one of six companies selected, out of a total of 50 candidate companies, to participate in the conference. We were the only small business selected. The other five organizations were: MITRE Corp., Lockheed Missiles & Space Co., Hughes Aircraft & Co., Boeing Military Airplane Co., and Fairchild-Weston Systems. Attached are copies of the original C3CM invitation extended to Greenbriar by the JCS, the letter from the JCS announcing our selection, and a letter of commendation following the conference. It is important to note that the opportunity for Greenbriar to participate in this high level conference, particularly as a new and unknown small business, would not have been possible if it were not for the SBIR program.

The following is a summary of the principal benefits that Greebriar has derived from the SBIR Program:

- Revenues from our five awards totalling more than $900,000.
- Invaluable experience as a consequence of researching and writing winning proposals. Because of the successes, there is an added confidence factor within the company associated with the development of new ideas and the willingness to pursue these ideas more aggressively.
- A substantial increase in credibility within the whole high technology community. This credibility translates into an added marketing resource and the achievement of a higher probability associated with the winning of R&D jobs.

- Marketing assistance as a consequence of the dissemination of information about SBIR winners by the sponsoring government agencies, by the Small Business Administration, and by such private sector organizations as the Small Business High Technology Institute.

- Opportunities to interact more realistically with the financial community including venture capitalists, private investors, banks, and large corporations, laying the groundwork for the critical financial requirements of the later SBIR phases.

In addition to our research activities directly related to SBIR awards, the principals of Greenbriar have become actively involved in a nation-wide high technology small business network. The purpose of this network, organized by and under the management of the Small Business High Technology Institute, is to encourage and promote participation in the SBIR program. The President of Greenbriar was instrumental in forming the Virginia Small Business Advanced Technology Association, which is the first state organization to be affiliated with the nation-wide network.

THE JOINT CHIEFS OF STAFF
JOINT ELECTRONIC WARFARE CENTER
SAN ANTONIO, TX 78243

RECEIVED SEP - 4 1984

30 August 1984

Mr. Dixon Cleveland
Greenbriar Systems, Inc.
8150 Leesburg Pike, Suite 511
Vienna, VA 22180

Dear Mr. Cleveland

On 5-6 February 1985 in San Antonio, Texas, the Joint Electronic Warfare Center and the USAF Electronic Security Command will sponsor the Fourth Annual Command, Control, and Communications Countermeasures (C3CM) Seminar.

The seminars bring together a panel of senior military and civilian executives, with a select audience, to discuss C3CM issues facing United States military defense planners and commanders. The 1985 session will focus on solution options for identified C3CM problems--instances where new or improved procedures, and new technology can be applied to our advantage. It will also look for ways to apply C3CM strategy in Joint operations.

As you can see from the enclosed tentative agenda, 30-45 minute presentations by industry representatives are a main feature of the program. We are asking organizations with special interest or experience in seminar topics to submit briefing abstracts to be considered for inclusion. On the basis of your involvement with battle management information systems and computer artificial intelligence, I invite Greenbriar Systems, Inc. to participate by submitting an abstract on Topic 3: "What is the role of decision aids in planning and executing the various options of the C3CM strategy?"

We have many systems capable of acquiring data about the enemy's command and control system. But our ability to fuze that data and present it in a useable form to the decision-makers is marginal at best. We need some near-real-time means to amalgamate the all source intelligence and present it in such a manner that it will help the commander answer these questions: "What is the enemy commander really doing?" "What can I do with Counter C3/C3 Protection to enhance my overall warfighting ability?" "What are my chances of success?"

To choose those contractors who will make presentations, I need a 300-500 word abstract of your proposed briefing, by 1 October. The abstract may be classified or unclassified and should clearly define the concept, methodology, or system to be briefed and its relevance to the topic. Later it may be necessary for us to get together to review candidate briefings. Please call me to discuss this further at AUTOVON 945-2071/Commercial (512) 925-2071. Major Edward Sheehan and Major Bill McGuire, AUTOVON 945-2146/Commercial (512) 925-2146, are the project officers for the seminar program. I look forward to hearing from you.

Sincerely

William D Meskill

WILLIAM D. MESKILL
Technical Director

Attachment
a/s

THE JOINT CHIEFS OF STAFF
JOINT ELECTRONIC WARFARE CENTER
SAN ANTONIO, TX 78243

RECEIVED NOV 9 1984

6 NOV 1984

Dixon Cleveland
Greenbriar Systems, Inc.
8150 Leesburg Pike, Suite 511
Vienna, VA 22180

Dear Mr Cleveland

I am pleased that your company has been selected to address the Fourth Annual C3CM Seminar on 5-6 February 1985, at Kelly AFB, San Antonio, Texas. You are one of seven contractors who will present ideas on how C3CM can be integrated into our operational strategy to improve warfighting capability. The focus of the seminar will be on problem solving. As in the past, the seminar format will be a series of presentations given to a panel made up of distinguished military and industrial representatives (Encl A) with an audience of 130 senior government and industry people. After each topic presentation is made, the panel and audience will engage in open discussion. The panel will provide a summary assessment and conclusion during the last seminar session. The tentative seminar schedule is at Encl B.

In your presentation, I encourage you to be innovative in addressing your topic area by examining the problems you foresee in areas such as strategy, tactics, data management, command and control linkage, procedures, and technology affecting the integration of a successful C3CM strategy. Your presentation is limited by the following constraints:

a. Presentation is limited to 30 minutes.

b. Security level is up to and including TS/SI.

c. Representatives from other industrial and military organizations will be present. All participants will be US personnel. Any information presented must be releaseable within DOD security guidelines.

My action officers have been in contact with you about a November working session to coordinate our efforts. If you require any further information, my points of contact are Major Ed Sheehan and Major Bill McGuire, AUTOVON 945-2146, or commercial (512) 925-2146. I look forward to your participation.

Best regards

John B. Marks

JOHN B. MARKS
Major General, USAF
Director

Attachments:
Enclosure A - Invited Panel
Enclosure B - Seminar Schedule

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28 FEB 1985

Mr Joseph A. Lahoud
President
Greenbriar Systems, Inc.
8150 Leesburg Pike, Suite 511
Vienna VA 22180

Dear Mr Lahoud

We just concluded the 1985 C3CM Seminar and it was a resounding success. Part of this can be attributed to the contributions of your firm. Mr Dixon Cleveland presented an outstanding briefing on the Intelligence Fusion process.

Annually we hold this seminar to help educate and inform senior DOD leaders and industrialists on the C3CM strategy. This year we focused our efforts on presenting ideas on how C3CM can be integrated into our operational plans to improve our warfighting capability. Your firm's briefing on "Information Feedback Control to All Source Intelligence Fusion" contributed substantially to accomplishing the seminar's objective of providing answers to the complex issues relating to the C3CM strategy and fired up the imagination of the participants.

Please relay my personal thanks to Mr Cleveland. His contributions were significant and reflect favorably on his professional competence and on Greenbriar Systems, Inc.

My best regards

John B. Marks

JOHN B. MARKS
Major General, USAF
Director

Mr. MAVROULES. Our next witness is Mr. John Stetson. Mr. Stetson?

TESTIMONY OF JOHN R. STETSON, PDA ENGINEERING, INC., SANTA ANA, CA

Mr. STETSON. Mr. Chairman and members of the subcommittee, thank you for inviting PDA Engineering to testify at this hearing. I will capsulize the written statement that I have submitted.

I am representing PDA Engineering and our president, Dr. John McDonald. We are a 75-percent employee-owned small business founded 12 years ago to do difficult research and development projects, primarily for the Department of Defense. Today, we have a staff of 112 people, and a well recognized reputation in the areas of composite materials, solid mechanics, fluid mechanics and the development and production of specialized hardware. Our services also extend to the commercial marketplace with our PATRAN-G computer graphics software and our THERMOSHIELD thermo protection system for downhole instruments in the oil fields.

Our company sales are approximately 50 percent to the Department of Defense and 50 percent commercial.

PDA's desire to be involved in the SBID Program was natural in accordance with our business objectives. Our participation in this program allowed us to improve our technology development goals. Additionally, the program provided an opportunity to develop new solutions to meet our customers' needs.

The research programs undertaken by PDA as a result of SBID awards, we feel most probably would not have been funded otherwise. PDA has been involved in the SBID Program since 1983. We have submitted phase I proposals to the DOE, NSF, NASA, and to the Air Force, Navy, and DNA.

Of 14 proposals submitted by us in the first two cycles, 1983 and 1984, we received 6 phase I awards. Three of these programs have subsequently been funded for phase II research and development.

The cost of preparing and submitting these proposals for us is significantly less than for competing in standard DOD procurements. As a result, PDA intends to increase our participation in the SBID Program. In 1985, we submitted 12 phase I proposals and 1 phase II proposal, which are currently under evaluation.

Our success to date with the SBID Program has been limited to awards for topics solicited by the Air Force. This is probably due to the fact that the Air Force is one of PDA's oldest customers, and we therefore understand Air Force R&D issues and requirements, perhaps better.

The R&D performed by PDA in these projects has contributed significantly to overall development of advanced missile systems and technology for the Air Force.

PDA anticipates that we will continue in the SBID Program as long as it is active. We hope to continue our phase II participation through fiscal year 1986 with programs for modeling and software development and for laser hardened and directed energy weapons materials response evaluations.

We also hope to identify phase III funding sources to continue these efforts; however, the subjects of our current programs are such that the ability to obtain nongovernment phase III funding is questionable. We do, however, look forward to additional DOD funding in these areas, since these products and services closely meet the mission needs of the Defense Department.

The technologies we have developed under the SBID Program are validated and available for broader application to other DOD programs as well.

Furthermore, our continued participation in the SBID Program will continue to improve our capability to compete in regular procurements.

Probably, the commercial applications of our technologies will be limited since our studies are directed toward specific DOD requirements. It is anticipated, however, that we will have indirect benefits to our commercial activities through the development of the analytical and software procedures that are being applied on these programs.

The specific benefits PDA has received may be summarized as follows: We have increased our ability to satisfy the Government's needs for new ideas and innovations. We have had the opportunity to participate with many other Government agencies. We have improved our capability to compete in conventional procurements, which have been made more difficult recently by the increased emphasis on competitive procurements.

The SBID procurement cycle does have lower bid and proposal costs for us, and to date, we have a higher capture ratio than for standard procurements. Unquestionably, demonstrably, there are increased sales and profitability in our company from the SBID Program, and with the prospects for future applications and phase III funding, the future looks bright in this area for us.

Government benefits that we perceive from the program include broader technology contributions to specific agency systems, programs and agency needs. Also, the ability to obtain new ideas and innovations that may not otherwise receive funding. Also, the Government agencies gain exposure to new small companies, and the increased capability and technology for small businesses can be applied to other Government procurements, as well.

Thank you.

Mr. MAVROULES. Thank you very much, Mr. Stetson, and your written remarks are accepted.

[Mr. Stetson's prepared statement follows:]

PREPARED STATEMENT OF J.R. STETSON, DIRECTOR, FLUID MECHANICS PROGRAMS, PDA ENGINEERING. INC., SANTA ANA, CA

The following statement describes PDA Engineering's participation in the SBIR Program for the past three years, products and services that have been developed with SBIR funds, our plans for continued involvement in the Program, future expectations, problem areas and benefits to both PDA and the Government from our participation in the Program.

Introduction

PDA Engineering (PDA) is a 75 percent employee-owned small business which was founded over a decade ago to take on challenging research and development projects, primarily involving the defense industry. Today we have a staff of 112 people and an outstanding reputation in the engineering areas of composite materials, solid mechanics, fluid mechanics, and the design, development, and production of specialized hardware. Our services now extend to the commercial marketplace with our PATRAN-G computer graphics software and THERMOSHIELD thermal protection system for down-hole instruments in the oil fields.

Sales for the fiscal year ended June 30, 1984, were $11 million. Our current sales are approximately 50 percent to the U.S. Government (primarily to the DoD) and 50 percent commercial and foreign. Engineering services (analysis, design, test and evaluation) account for approximately 50 percent of sales; products, specifically CAE software, aircraft stores and oil field thermal protection systems account for the remaining 50 percent of sales.

PDA's organization consists of an Engineering Services and Products Division and a Software Products Division. It is the former division that sells primarily to the U.S. Government and, therefore, benefits most from the Small Business Innovation Research program.

Participation in SBIR Projects

PDA's desire to become involved in the SBIR program was a natural extension of our corporate objectives stated above. Participation in this program allows us to increase and improve further our technology development goals. Additionally, the program provides us the opportunity to develop new solutions to meet our customers' needs. Most of these research programs undertaken by PDA as a result of SBIR awards would not have been funded otherwise, or would have been funded at lower levels within other contracts.

PDA has participated in the SBIR program continuously since the 1983 procurement cycle. We have submitted Phase 1 (project feasibility) proposals to the DoE, National Science Foundation, NASA and to the Air Force, Navy and DNA components of DoD. Of 14 proposals submitted in the 1983 and 1984 cycles, we received six Phase 1 awards. Three of these research programs were subsequently funded for extended Phase 2 research and development. The attached table summarizes PDA's bid and award experience, including anticipated revenues from Phase 1 and Phase 2 awards. It is significant to note that cost of preparing and submitting these SBIR proposals is less than for standard DoD competitive procurements. As a result, PDA has attempted to increase our participation in 1985, submitting 12 Phase 1 proposals and one Phase 2 proposal.

Our success to date with SBIR programs has been limited to awards for topics solicited by the Air Force. This is probably due to the fact that the Air Force is one of PDA's oldest customers, and we therefore have a better understanding of specific Air Force R&D issues and requirements.

Products/Services Developed with SBIR Funds

The following are examples of research and development services for which PDA is currently funded under the SBIR program:

1. Development of software and mathematical models for analysis and evaluation of advanced reentry vehicle thermal protection materials, such as antenna windows and nose cones in the hypersonic flight regime and in erosive weather environments (3 Phase 2 programs).
2. Analyses and evaluations of ICBM materials and structural response to directed energy (e.g., laser and other EM) weapons effects (2 Phase 1 programs).

The research and development performed by PDA on these projects have contributed significantly to the overall development of Advanced Missile Systems and Technology for the Air Force. Although one or more of the above research and development activities might have been included in a standard competitive procurement, it is unlikely that innovative approaches developed by PDA would have been funded in the absence of the SBIR program.

Future Expectations for Products Developed

PDA's goals for the R&D efforts we are performing under the SBIR program are to improve our technical capabilities and contributions to specific needs of the DoD in the following areas:

- provide improved capability for design, evaluation and performance predictions of hypersonic vehicle thermal protection materials,
- make direct technical contributions to the design and evaluation of laser and DEW hardened materials,
- develop improved test techniques for EM sensors in hypersonic vehicles,
- examine the feasibility of new ICBM defense concepts.

PDA anticipates continued involvement in the SBIR program as long as it is active. We hope to continue our FY86 Phase 2 participation in modeling and software development and in laser hardened materials response evaluations. We also hope to identify possible Phase 3 funding sources to continue these efforts. However, the subjects of our current SBIR programs are such that the ability to obtain non-Government Phase 3 funding is unlikely. We do, however, look forward to additional DoD non-SBIR funding, since these products and services closely meet the mission needs of the Defense Department.

Most probably, the future commercial application of this technology will be limited, since most of PDA's studies are directed toward specific DoD requirements. It is anticipated, however, that there will be indirect benefits to our commercial activities through the development of analytical and software procedures to be applied to these programs.

Problems Encountered with SBIR Participation to Date

These problems appear to be minor compared to the overall benefits received from the SBIR Program:

1. There appears to be a low "win" probability for proposals to new customer agencies (i.e., "blind" proposals). PDA has received no awards from other than pre-existing customers.
2. There is a lack of continuity between Phase 1 and Phase 2 programs. Although not intended, this requires some shuffling and reassignment of personnel.
3. Because PDA's programs have limited commercial potential, non-DoD funding for Phase 3 programs is unlikely.

Summary and Conclusions

PDA's basic capabilities lie in structural and dynamic analyses, materials evaluation, thermal and fluid flow analyses, mechanical design,

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fabrication, and testing, as well as computer software development to support these technologies. PDA is expanding and adapting its technologies to a broad customer base, both government and commercial.

The benefits PDA has received from SBIR participation include the following:

1. expanded applications of existing technology capability,
2. increased ability to satisfy agency needs for new ideas and innovation, -
3. opportunity for participation with other government agencies,
4. lower bid and proposal costs and higher capture ratio than for standard competitive procurements,
5. increased current sales and profitability,
6. prospect for future applications and (Phase 3) funding from DoD.

The benefits to the Government include:

1. Broader technology contributions to specific agency systems programs and needs.
2. Ability to obtain new ideas and innovations that may not otherwise receive funding,
3. Agency exposure to new small companies.

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TABLE 1

PDA SBIR EXPERIENCE

	U.S. FY83	U.S. FY84	U.S. FY85
Phase 1 Proposals Submitted:	DOE - 2 USAF - 4 DNA - 1 NSF - 1	USAF - 3 USN - 2 NASA - 1	USAF - 12
	8	6	12
Phase 1 Awards	4	2	TBD
Phase 2 Awards	--	3	TBD
Revenues from Awards	170K	643K	805K (Est)*
Direct B&P Costs	14K	8K	20K

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* Includes revenues from FY84 Phase 2 programs

Mr. MAVROULES. Our final witness of this panel is Dr. Fritz Bien. Dr. Bien?

TESTIMONY OF FRITZ BIEN, PRESIDENT, SPECTRAL SCIENCES, INC., BURLINGTON, MA

Mr. BIEN. Thank you, Mr. Chairman, and members of the subcommittee. My name is Fritz Bien. I am the president of Spectral Sciences, of Burlington, MA.

Spectral Sciences, Inc., I will describe in a little more detail, because I think it is sort of different from the other small businesses and yet very much the same.

We were founded in 1981 by a group of scientists of five in total to do nothing but Government contract research and study the phenomenology of rocket plumes in the atmosphere.

The Small Business Innovative Research Program has given Spectral Sciences the opportunity to have our very diversified group of talent which included physics, chemistry, spectroscopy, and fluid mechanics, to diversity and apply our expertise to other Government problems, problems that we would never even attempt to try to market, because we did not know how to start.

Since the formation of the SBID Program and also the DSAT Program before it with the Defense Department, we have had seven phase I programs. We are currently carrying on a phase II program, and because three of the phase I's are of the current period, we are currently submitting three phase II proposals. Because of these related efforts, we are really expanding. We are going to grow from 5 to maybe 10 people by the end of the year.

The economy requires that certain niche companies like ourselves be confined just to research. While we intend to grow as a benefit of SBID, the real potential for employment growth really lies in the potential commercialization of the products. I think this is the purpose when we started with the SBID Program.

For this reason, we teamed with another small company, Pacer Systems of Burlington, MA. This teaming process represents, I think, an overlooked aspect of SBID. The team ventures multiply not only the brain power of the various people assigned to the task, but they also offer two or more firms a greater opportunity to build themselves and expand the taxpayer return. The movement into the commercial market segment will be carried out by Pacer Systems, and what does Spectral Science get out of it? Well, we are able to explore these new areas of research and develop our laboratory computer and manpower facilities to later bootstrap ourselves into a position where we can choose these other avenues of growth.

The SBID Program has greatly helped us, because we lack the marketing expertise to expand our customer base into all these new areas, even though we have all the technical expertise.

With the solicitation brochures, which I would like to compliment the agencies for, we were able to explore the needs of a much wider customer base to which our talents can be applied. In particular, the field of trace gas analysis in which we have won the majority of our SBID contracts.

We can address our expertise in understanding gas phenomenology to various niche parts of the market, and we are developing essentially moisture monitors now for the nuclear reactor industry, hydrogen detectors for NASA and poison gas detectors for the Air Force and the Army.

So the actual commercial applications have not been tapped, and we hope that somehow by teaming with other small companies and with larger companies, we will be able to learn and bootstrap our way into that development ourselves.

Meanwhile, I think that the technology advances in this Nation are dependent on programs such as SBID to enable firms as ours to commit solely to the research process through the innovative portion of the research rather than have to siphon off our valuable resources, both manpower and money into going to production just to stay solvent.

SBID plays another critical role, I think, in keeping the United States ahead of our international technology advancement that all these other countries are threatening us with, and it is something that the administration should keep in mind when they are trying to limit our SBID expenditures.

As a small business owner, a taxpayer, a researcher, I urge that the SBID Program be fully funded and expanded and reauthorized past 1987. In fact, you know, being I guess slightly prejudiced myself, I would suggest that America retain a greater technology preeminence through this expanded program. Thank you.

[Mr. Bien's prepared statement follows:]

PREPARED STATEMENT OF FRITZ BIEN, PRESIDENT, SPECTRAL SCIENCES, INC., BURLINGTON, MA

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Spectral Sciences, Inc. (SSI) was founded in January 1981 by a group of experienced scientists who had been doing government contract research for many years in the field of physical phenomenology related to optical signatures from rockets, aircraft and nuclear events. With a greatly developed expertise in a very wide variety of disciplines including fluid mechanics, spectroscopy and chemical physics yet directed toward a very narrow problem, SSI was successful in maintaining enough business to keep the principals very busy. The Small Business Innovation Research Program has given SSI an opportunity to apply its expertise in new problems.

Since the formation of the SBIR program and its predecessor, the DSAT program, Spectral Sciences, Inc. has worked on, or is working on, 7 SBIR programs. These programs have been through a wide range of sponsors, 3 from Department of Energy, 2 from the Air Force, and one each from the Army and NASA. We are currently working on one Phase II program, and have, or are submitting 3 other Phase II proposals. Because of these and related efforts, SSI will have doubled its initial 5 person company by September. While this increase in employment seems small, it is because it has been a conscious decision on the part of SSI.

Economy requires certain niche companies like ourselves to be confined to research. While we intend to grow as a benefit of SBIR, the real potential for employment growth lies in the potential of product commercialization. This is the reason we have teamed with Pacer Systems of Burlington, MA. This teaming process represents an overlooked aspect of SBIR Teamed ventures multiply not only the brain power assigned to the task, but offer two or more firms greater opportunity to build themselves and expand taxpayer return. The movement into the commercial market segment is thus carried out by Pacer Systems, Inc., which has the manufacturing and marketing expertise to make a successful entry into a very competitive market. SSI is able to explore these new areas of research and develop the laboratory, computer and manpower to bootstrap itself into a position in which it can choose this other growth path.

The SBIR program has greatly helped us because we lack the marketing expertise to expand our customer base into these new areas. With the SBIR Solicitation brochures, we are able to explore the needs of a much wider customer base in which our talents can be applied. In particular, the field of trace gas analysis instruments has been a natural niche for the company which understands the phenomena associated with the gases. The instrumentation to date have been addressing a specific problem and small segments of a small market. These include a moisture monitor being developed for the HTGR nuclear reactor, a hydrogen detector for use with filling the space shuttle, both remote and point sensing, poison gas detectors, and hygrometers for meteorology. The actual commercial applications of these products have not yet been tapped. It is the current plan to use the development of these technologies to bootstrap our way into producing specialty instruments, which can then be generalized into commercial products. We will continue to license these technologies to other companies until we can comfortably move into product development ourselves.

Technology advances depend on programs such as SBIR that enable firms such as ours to commit solely to the research process, rather than have to siphon off valuable resources in production to stay solvent.

SBIR plays another critical role in keeping the U. S. ahead of international technological advancement, which is administration should keep in mind as it proposes to limit SBIR expenditures. As a small business owner, a taxpayer, and a researcher, I urge that the SBIR program remain fully founded and be reauthorized in 1987. In fact, I'd suggest that America can retain even greater technological pre-eminence through expanded SBIR funding.

Mr. **Mavroules**. Thank you all very much for your testimony. I have three questions I am going to address to you, Dr. Lonsdale. You really perked my ears when you mentioned three different areas. Maybe you can elaborate a little bit.

I think we are going to be interrupted in a few minutes for a roll-call. If that does happen, we will go over and vote and come back and continue with the hearing this morning.

You mentioned that through the SBID Program you are developing technologies to eliminate acid rain. Of course, we all have an interest in that.

Of course, this is a very important issue, and not only in New England. I would like you to elaborate on your research, first of all. Could you also expand upon your experiences with NIH? I believe you referred to that when you testified. Another question I have really hits home to me personally, because I have large leather manufacturing groups in my district. We are having a hell of a time with chrome waste. You said you worked with chromium waste. Maybe you can elaborate on that too. I think you referred to steel, but maybe you can relate that to leather.

Mr. **Lonsdale**. First of all, acid rain. The truth will come out. In fact, all work on acid rain right now is not yet funded under an SBID Program. The work is in the form of a proposal only, thus far.

However, we think we have a very good idea for controlling acid rain, and I might just elaborate on that for you. Acid rain is made of sulfur dioxide, which comes out from sulfur-containing fuels, coal and oil. With membranes like this, one can scavenge that sulfur dioxide so that the sulfurous and sulfuric acid are not formed and are not sent downstream in the plume from a power plant generator. This idea is not yet funded, but we think it is possible to take those acid ingredients, or acid-forming ingredients, out of plumes from power plants.

As for NIH, I said in my written comments, but I did not say it orally, of the 11 or 12 SBID funding agencies we found real resistance only at NIH. I do not mean to be mean to the NIH people. They are as dedicated as the other people in the program. However, there is an onerous section in the NIH appropriation legislation—section 202 by number—that prohibits NIH from paying the full cost of its research, either under the SBID Program or any other program they fund.

They insist on cost sharing, and while the cost sharing may seem to be minimal, by the time all is said and done, the cost sharing amounts to something like 10 percent or more from us. We find that to be counterproductive. We think the most innovative companies in the United States are not submitting proposals in the numbers they might to NIH because of the cost-sharing stipulation in their appropriations legislation. We have been trying to get that language out of the legislation for the last year or so—without success thus far, I might add.

Finally, chrome wastes. The thing that brought Bethlehem Steel to us, as I may have mentioned, is that under a very early program, we had, in fact, found a way to remove chrome from liquid wastes, whether they are steel wastes, plating wastes, leather wastes, or what have you. We are just now producing modules like this—we call them modules—to be used in the Sparrows Point, MD, plant outside of Baltimore, owned by Bethlehem Steel, for removing chrome from their wastes. It can be just as easily adapted to the leather industry, in my opinion. We are testing the modules in Sparrows Point on steel wastes, however.

Mr. **MAVROULES**. Thank you very much.

Mr. **CONTE**. Could I follow up on that?

Mr. **MAVROULES**. Of course, Mr. Conte.

Mr. **CONTE**. On acid rain, you really have not begun your research?

Mr. **LONSDALE**. Only a small amount in the laboratory thus far. We are not yet funded under SBID. We are just doing it under our own internal research and development program.

Mr. **CONTE**. What type of research are you going to do? Are you familiar with the program the University of Massachusetts is doing on acid rain?

Mr. **LONSDALE**. No, I am not.

Mr. **CONTE**. They are really getting into it very big. They are testing water all over the western part of Massachusetts getting the acidity count and all that. I think it would be worthwhile if you two got together, but go ahead and tell me what you plan.

Mr. **LONSDALE**. I do not want to make it too detailed, but there has been a revolution in our industry as well. It is the membrane technology industry. This is now about a billion-dollar-a-year industry worldwide—membrane separations, largely. What has happened in this industry is first, we have been able to make membranes that are extremely thin. If I were holding one up, you could not see it. The membranes in this module, in fact, are effectively that thin. You can see them, but in fact there is a skin that you cannot see, and that is where the action is in these membranes.

Second, we have been able to develop what we call facilitated and coupled transport—those are only words to you. We can put a carrier inside our membranes—a carrier that is specific, for instance, for SO_2, which is the principal ingredient in acid rain, and we can pick up SO_2, at very small concentrations, transport it across the membrane to the downstream side, where we can concentrate it. In fact, we can take it off and strip it and produce sulfur out of it, for example. The process is still not commercially viable, but we think we have a good idea for doing that with these so-called carrier-type membranes. It is technology, and I do not want to spend a whole lot of time bending your ear about it.

Mr. **CONTE**. It is worth bending my ear about it, because I will tell you, it is serious up in New England. We have lost I don't know how many lakes in our district, quite a few. The drinking water now at Quabbin Reservoir, which is the reservoir for Boston, they have to spend about $1 million a year to lime it to bring the acidity down every year. Compounded with that, Boston has some of the old lead pipes, and as you know, that is how they all died in Rome during the days of the Romans. I am very interested in it, and anything you do on it, I would like to know.

Mr. **LONSDALE**. Thank you.

Mr. **MAVROULES**. Thank you very much. I appreciate the response. I do have questions for the others, but I am going to defer at this point to my colleague. Mr. Bedell, do you have any questions?

Mr. **Bedell**. I can do it in 2 minutes, I think. First of all, I want to thank all of you. You have helped us very much by helping to point out the importance of the SBID Program, and that is important to us as we try to preserve this very, very important program.

Dr. Lonsdale, in regard to your membrane technology, are you foreseeing the possibility that you would put these in the stack of a plant instead of installing scrubbers?

Mr. **Lonsdale**. That is the idea. Most stack gases, in fact, are a fairly low temperature, and these membranes will stand those temperatures, we believe.

Mr. **Bedell**. Is your estimate that it would be more effective than scrubbing or less costly than scrubbing?

Mr. **Lonsdale**. I think less costly, although it is very early to tell, Mr. Bedell.

Mr. **Bedell**. You have done work on alcohol fuel, and one of the problems there is the separation of alcohol from water. They are using stills at this time to do that distillation process.

For a long time, there have been a lot of hopeful indications that we would be able to separate the alcohol through membrane technology, and I have not heard anything about it lately.

My question to you, as a separate question, is whether progress is being made generally in membrane technology so we might look forward to the likelihood of this occurring, or was that a pipedream that we were told about 2 or 3 years ago? Do you have any knowledge at all in that regard?

Mr. **Lonsdale**. I do. There is plenty more work going on outside of the United States on that separation than there is within the United States. The leaders in the world are probably the Germans and maybe the Japanese. The Japanese are outspending America in membrane R&D at least three to one right now.

Anyway, there is some hope. It is a difficult problem. What one can ultimately do with membranes is break what is called the azeotrope. The difficult part in separating alcohol from water is getting around what is called a constant boiling mixture. You can make pure alcohol using membranes because they would allow us to get around that constant boiling mixture, but they will not perform the full alcohol/water separation. One will combine a membrane system, I believe, with a distillation system, but lower the overall energy costs.

Mr. **Bedell**. Mr. Stetson, you say you have over 100 employees in your firm. I do not know what the regulations are in your type of business.

Mr. **Stetson**. 500 for small business.

Mr. **Bedell**. So you have got a long way to go. You do both apparently. You bid in regular contracts and you bid under the SBID Program.

One of the complaints we get is we are told that the SBID Program prohibits legitimate bidders from having an opportunity to compete so that if a firm similar to yours had 520 employees, they would not be able to fairly compete with you.

How would you answer that in your opinion?

Mr. STETSON. The answer to that is that the SBID is directed toward particular topics which agencies are requesting work be done on for their own needs.

These are topics that the smaller companies are best geared to work on, to bid on. They require innovation, and they require the application of skills that small businesses are probably better capable of handling than larger companies. Larger companies are more interested in big systems.

Mr. BEDELL. I yield back the balance of my time.

Mr. MAVROULES. Mr. Cooper?

Mr. COOPER. Thank you, Mr. Chairman. I appreciate this excellent testimony, and I am personally glad to see so much innovation going on nationwide. I think you gentlemen are a credit to the economy of this Nation.

If you will permit me to play devil's advocate for just a second, and as you realize, we just have a second. I have two main concerns. I still cannot understand exactly what it is about smallness per se, that prevents your ideas from being able to compete in the marketplace of ideas.

Why does the Government have to make a difference? Is there some beltway mentality that prevents folks from dealing with a smaller company? I realize it could be more trouble, but if you are just looking at the marketplace of ideas, it seems to be counterintuitive why we have to have a rigid arbitrary set-aside to do that.

My second question is this, if you take a program like student loans, that is a Government investment in the most basic form of R&D, if you want to look at it very broadly. The Government expects those students to pay that money back.

I wonder again, playing devil's advocate, whether the Government might be short changing itself and short changing the American taxpayer if they ask for nothing in return from you guys. As Mr. Lonsdale pointed out, a venture capital firm can take control. There are other ways to get financing, I suppose, but isn't the Government kind of giving you all a freebie when it does not ask for much of anything in return other than the general societal benefits that might flow from your research? Those are my two concerns.

Mr. MAVROULES. We do have a rollcall now. Why don't you hold the answer to those questions until we return?

Mr. STETSON. I would like to comment on the first one.

Mr. MAVROULES. Fine. Just please forgive us for the inconvenience. We will be right back.

[Recess.]

Mr. MAVROULES. The hearing will reconvene. Mr. Stetson, you indicated that you would like to reply to Mr. Cooper.

Mr. STETSON. I believe, Mr. Cooper, your first question had to do with "Are small businesses being given an advantage in these types of procurements?"

Mr. COOPER. More specifically, exactly what is it about smallness that means you are so discriminated against by these agencies that we have to have a crude test like this to force allocation. Exactly what is it about smallness?

Mr. STETSON. I do not know how to express it. It can be classed as discrimination. However, in the particular areas that we work in, that is, DOD procurements, our usual competitors are major aero-space companies, specifically General Electric, AVCO, and McDonnell Douglas, and others.

Those companies, each of them has internal R&D budgets which far exceed our sales over a 5-year period. When we compete to the Government for technology programs or development programs; although they are very competent research companies all of them, there is no way we can beat them on a bid—price—basis. They can underbid us every time.

We can ill afford to take a job at a loss.

Mr. COOPER. Are you accusing them of predatory pricing, pricing their services below their costs?

Mr. STETSON. No, that is not something that I can——

Mr. COOPER. Are your costs higher than theirs, and they are able to price above their costs, but still below yours?

Mr. STETSON. They can operate on a lower profit margin, if you wish. Any larger company can.

Mr. COOPER. Inherent inefficiency can operate at a lower profit margin than you can?

Mr. STETSON. In a specific area.

Mr. COOPER. And still be making a profit on that service they are providing?

Mr. STETSON. I do not know.

Mr. COOPER. So you do not know whether you are accusing them of predatory pricing or not?

Mr. STETSON. I can only make the statement from past experience that when we go up against them in specific areas, we are always underbid.

Mr. COOPER. I do not mean to get off on this side issue, but it seems to me that what small firms lack might be prestige. You know, a bureaucrat might be unwilling to take a risk and go with XYZ Co. which he has never heard of rather than just give it to IBM or McDonnell Douglas.

Mr. STETSON. That is another.

Mr. COOPER. If it is prestige that you need to be granted, what is it about a Government agency that should be in the business of granting prestige? Can a Government agency do that better than a private agency?

We have good housekeeping seals of approval for retail products, and I am the first critic of a lot of these national testing laboratories for a lot of our small business products. I think they tend to exclude products, but I think it is a curious anomaly to see small businessmen interested in the free enterprise system saying that only the Government can grant prestige certificates to individual small businesses to allow them to compete.

In a sense, this is not just a prestige certificate. This is a quota, as I understand it. If I were a Nobel Prize winning scientist, and I had an acid rain idea, and I was part of a company with more than 500 employees, Mr. Lonsdale's firm would get the contract regardless of the merits of my idea. Is that correct?

Mr. LONSDALE. Could I respond? If you have a great idea, and you are in a company with more than 500 employees, you will certainly see the idea come to life.

Mr. COOPER. But not through——

Mr. LONSDALE. Not through SBID, that is true. You raised two questions, Mr. Cooper, both good questions. I compliment you. Let me try to give you my own version of answers if I could.

First, I am a poor man; I am a chemist. We started our company with $5,000 10 years ago. Try to do some R&D with $5,000 in high tech. You just cannot. So we have turned to Government and private contracts to support the development of our innovative ideas.

What we need to get those products out there is capital. We need visibility and credibility. I use a different word, but I certainly agree with what you say.

How are we going to compete with Boeing, Stanford, and Harvard or Vanderbilt, if you will, from your State? If you had a proposal to review that said "Harvard" on it and one that said "Boeing" on it and one that said "Bend Research" on it, and you did not know any more about those companies than those addresses, who would you fund?

I suspect you might fund the more famous of those organizations. We have that problem. We have had that problem in small-business high-tech companies in the United States, I think, from the beginning of Government-sponsored R&D.

Mr. COOPER. Surely the requirements of our bureaucrats are more sophisticated than to look at the Ivy League nature of the title on a proposal. It seems to me it boils down to an accusation of arbitrariness on the part of bureaucrats, not really arbitrariness, but rather extreme status consciousness.

Mr. LONSDALE. I think there is some of that. I guess I would have to agree.

Mr. COOPER. I think that is a legitimate complaint. I see that myself. I just worry about this crude device of an absolute quota.

Mr. LONSDALE. The bottom line in my opinion is: It is working well, and it is going to work magnificently well over the next few years.

Mr. COOPER. We are seeing the success stories right here. We are not seeing the companies that are already bust because they did not get an SBID grant.

Mr. LONSDALE. That is true.

Mr. COOPER. Or we are not seeing the good ideas from a major company that were not funded because they could not participate in the program.

Mr. LONSDALE. Presumably a major company could fund it itself. Companies with 500 employees generally have a fair R&D budget of their own, or they can go to a Government agency outside of SBID.

Mr. COOPER. Presumably, but I see in my own district a number of firms that deliberately stay under 500 people just so they can benefit. It's an inhibitor to growth.

The more important question is really whether the Government is getting short changed or not and the student loan analogy. I worry that if we require poor students who oftentimes do not have jobs to pay back every dime, and the Government does not get anything from you guys.

Mr. LONSDALE. Could I? We pay income taxes like everyone else does.

Mr. COOPER. So do students, if they can get a job.

Mr. **Lonsdale**. The income tax laws now say that a corporation, when it exceeds the maximum—that is the threshold $100,000 in profit—and that is not much in today's society—one pays the same income tax rate as General Motors or Exxon.

Mr. **Cooper**. You are looking at the nominal rates. Does your firm claim any investment tax credits or accelerated depreciation?

Mr. **Lonsdale**. Some, but we still pay close to 50 percent in our small company in State and Federal income taxes.

Mr. **Cooper**. You need to get a new accountant.

Mr. **Lonsdale**. Maybe. We use a "Big Eight" firm now. In addition, we create jobs, and those employees also pay taxes. What our company is all about, really, is not just bottom-line profits. It is creating jobs. We are very sensitive to the fact that there is large unemployment in our part of the world. In central Oregon, it is atrocious because of the bad timber industry. We are creating jobs. That is our payback, as it were.

Mr. **Cooper**. Look at the Chrysler analogy. Chrysler needed help. It was a significant sector of the economy. We needed that company and Congress voted to help it. In return, the Government received warrants. The Government has ended up making a fantastic profit or gain out of those stock warrants. Would you find the idea abhorrent if the Government, whether through a Guaranteed Loan Program or Direct Loan Program, maybe even one of these R&D set asides, took a small, say 5 percent ownership share in your company?

Mr. **Lonsdale**. I would not find it abhorrent. I would also say, however, that if Bend Research went belly up, the Government would not bail us out.

Mr. **Cooper**. That is for sure, but in return for Government service the idea of user fees is gaining credibility. If you have a private airplane and you use an airport, the Government has subsidized you over the years. The idea is gaining currency now that that should be evened out. There is not a subsidy granted to private airplane owners. It seems to me that in the cases where the Government really helps you out, and you can afford to do something for the Government other than the universal requirement that people pay income tax, that that should be required. Otherwise, maybe we should be more lenient with our students.

Mr. **Lonsdale**. Mr. Cooper, I would not argue with a payback provision of some sort. I think it is probably fair.

Mr. **Mavroules**. Mr. Lahoud?

Mr. **Lahoud**. I guess I go back to the really fundamental nature of what kinds of things the country needs that are being provided by the private sector, and if those needs are not being provided for by the private sector, then the Government considers jumping in and doing something about it.

Mr. Conte referred to the study, the statistics, that showed the benefits of the small high technology companies and the innovations that are coming from the small high technology sector, but these small high-tech resources that exist around the country are not being realized.

Something is keeping those ideas from being developed, but yet when the encouragement is there, the small high-tech people somehow are able to get those innovations out to the marketplace. So to me, I look upon the SBID Program as a vehicle. It is my understanding that that was the very early stages of the thinking of it.

It is a vehicle to somehow get those resources that now are being stymied for reasons that a lot of people do not understand. Everybody has got their ideas as to why the small companies cannot get Government contracts as easily as the large companies, but we basically make the observation that there are small high technology resources in this country that are dying. Companies are going out of business for whatever reasons. Let's encourage them somehow, and to me, that is what the SBID Program is doing, and ultimately if the SBID Program works, if what I have seen in my company is going to work, then the private sector will pick up what is now taking place in the Government.

If paybacks is part of what should be done now, I do not have any problem with that either. To me, SBID is a way to solve this problem, getting the small high tech resources going and then keep it going somehow and the Government get out of that business.

Mr. **Cooper**. Can any of you gentlemen think just off the top of your head what some sort of fair payback system would be? For example, with each of your companies, how much do you owe the Government if we adopt a payback system?

Mr. **Bien**. I guess I am kind of naive on this question, because what I do not understand is we have responded to SBID contract proposals. We were trying to help the Government develop particular needs, as with the Armed Forces, they have particular needs or particular instruments which will help them solve very specific problems for $50,000 which is really just seed money.

We are putting in a lot of our own time. I understand Dr. Lonsdale's complaint that the extra 10 percent taken out for NIH is quite a large hunk for small businessmen. Now, we understand that 99 percent of the companies in the United States and 100 percent of all of the new hires in 1983 were from small businesses, that we should really look for ways to pay back this 1 percent of this very large Government procurement that puts all this R&D money into the GE's, General Motors, General Dynamics. To do the little seed type research that we are trying to offer solutions to Government problems for 1 percent of the R&D budget.

I guess I just do not understand your question.

Mr. **Cooper**. Believe me, I am not interested in letting the large companies off the hook, I am a firm believer that some of these companies are not even paying income tax, which Mr. Lonsdale stated was the universal obligation.

I am just searching for a way, and all of us are terribly concerned about the deficits. We have to do something about it. Every single committee that meets, the people that testify say "preserve my program." I am looking for a way that we can keep this program alive, because it is a great program, and I am a strong supporter of it, and yet do something to improve the funding of the program.

My time has way expired, and the chairman has been very indulgent.

Mr. **Mavroules**. It has been an excellent exchange. Do you want to respond, Dr. Lonsdale?

Mr. LONSDALE. Just briefly, if I could. I would say that if the Government wants a return—and maybe it is entitled to it—give the Government an extra percentage of our profits. Right now, it already gets a percentage—namely, income tax.

If you want a greater percentage, I would say take it out of profits on sales of the products that the SBID Program helped to develop. I would be willing to see that happen.

Mr. MAVROULES. Let me respond just briefly. I also serve on the Armed Services Committee, and a lot of the R&D money is given for the purposes of competition, whether or not it is going to be better for all the taxpayers in the country.

An awful lot of that money, by the way, is not paid back to the Government. Some is, some is not. My point, though, relates to national security. Competition may increase the national security of our country.

If you fellows are looking for some loopholes, listen to what Mr. Cooper is saying, because we do have a very serious problem, as you referred to before, Dr. Lonsdale, with the budget. We have to get some revenue coming into this country of ours. The day is coming very shortly when we will have to face up to it.

I have a question for each of you. Mr. Lahoud, have there been any immediate results from your participation in the DOD C3CM conference? Do you have any comments on that?

Mr. LAHOUD. As I indicated in my written testimony, the work that we did in phase I for the Army produced results which are getting considerable attention from other DOD agencies, the other services, the Air Force and from the Navy.

We were invited to participate in this conference in Texas along with half a dozen very large defense contractors. Greenbriar, in the opinion of the reviewers, had a unique approach to the solution to some battle management type problems.

I guess the immediate results are that we have been informed by the Army that they want that work to continue into phase II. We have been invited by the Navy to submit a proposal for similar work in the Navy area. We are proceeding in a half a dozen other very specific problems that we are pursuing with other DOD agencies.

Mr. MAVROULES. So, you would say that you have had some immediate results?

Mr. LAHOUD. I would say absolutely, and that was just from phase I, not even getting into phase II.

Mr. MAVROULES. Very good. Mr. Stetson, you stated you do extensive work with DOD. How do you feel about the SBID Program within DOD, and how it is run?

Mr. STETSON. To date, I think it has been run very well. The SBID Program, we have benefited considerably, as I indicated in my remarks. It has improved our sales upward of 5 percent in the last year as well as our employment, and I feel that it provides an outstanding opportunity to do things that we would not otherwise get to do and that the Government would not otherwise have the benefit of.

Mr. MAVROULES. In other words, if I read you correctly, in your estimation, it is being run efficiently and effectively, and it is useful.

Mr. **Stetson**. Yes.

Mr. **Mavroules**. Thank you very much. I have a final question for Mr. Bien. You stated that you have a team effort with Pacer Systems. What attracted your two companies to work together?

Mr. **Bien**. Yes; Pacer Systems is a large company by our standards, but a small company by I guess the definition of 500 employees. We initially got together in a program called the Small Business Technology Group that was organized and brought through, I guess, the small business office down through here. What we were looking for was a match of a corporation that would have the marketing, and the production expertise which we did not want to develop because we wanted to stay in the research to try to answer our Government's needs so to speak in the various problem areas.

I would like to say that we also team on nonsmall business ventures with companies like Aerojet General in Azusa, CA, and Honeywell Electro Optics Systems.

We are very familiar with teaming with larger corporations. With the SBID-type programs, where we are trying to develop specific instrumentations, the very large companies are not interested. They do not want to devote a lot of R&D for a very limited market. I think this is where the SBID Program really benefits the country, because there are these needs for instrumentation that nobody else wants to touch.

Mr. **Mavroules**. Very good. I do not have any other questions. I would ask Mr. Bedell and Mr. Conte, do you have other questions of this panel?

Let me thank you all very much for your excellent testimony this morning. You have been very helpful.

I would now call upon our next panel. We have Dr. Kris Joshi and Dr. Peter Pronko from Universal Energy Systems from Dayton, OH; Dr. Jack Saluja, Viking Energy Corp., Pittsburgh, PA; and Dr. Peter Andrulis, Andrulis Research Corp., from Bethesda, MD.

Because of time constraints, I am not going to rush you but see if you can capsulize your opening statements. We will include your entire testimony for the record.

I would now like to call upon Dr. Kris Joshi.

TESTIMONY OF DR. KRISHAN K. JOSHI, PRESIDENT, ACCOMPANIED BY DR. PETER P. PRONKO, CHIEF SCIENTIST, UNIVERSAL ENERGY SYSTEMS, INC., DAYTON, OH

Mr. **Joshi**. Mr. Chairman, it is a pleasure to address this committee today. As the president of Universal Energy Systems in Dayton, OH, we are pleased to have an opportunity to discuss the Small Business Innovative Research Program and our experience with it.

UES is a high-tech company which provides research and development services to industrial and Government clients. We employ approximately 120 people, 10 of whom are funded by the SBID Program.

Our total corporate revenues for 1984 were $6.5 million and are expected to approach $9.5 million in fiscal year 1985.

Approximately, one-half of the company's resources are committed to the physical sciences. To support this commitment, we have made a major investment of approximately $2 million in a modern state of the art material research laboratory. Advanced research in solid state physics, metallurgy, and ceramics is conducted within this facility.

For Universal Energy Systems, which is a small 8(a) business, the SBID Program has been a dynamic tool which we have used to foster new technology for the research and development community and for the commercial marketplace.

We feel that the technology we are developing through the program has already had an impact on our immediate economic area and that it will eventually impact the Nation.

We recently started to provide our services in R&D technology to Japan, Canada, and France. Mr. Chairman, the impact of the SBID Program on UES has been extensive.

No. 1, the SBID Program has been a key factor in supporting the growth of our in-house laboratory, our materials research programs and personnel.

No. 2, the SBID Program has alerted us to various research and development opportunities and has streamlined the submittal of unsolicited research ideas to the appropriate Government agencies.

No. 3, the program has helped us to improve our marketing efforts by providing access to information concerning potential program requirements, agencies, and customers.

No. 4, to take advantage of the opportunity of commercialization of phase III SBID Programs, we have begun to build a small network of interested investors to provide capital for this development. In fact, this afternoon we are flying to Boston to investigate the purchase of a high current ion beam implanter which will commercialize our process development.

No. 5, to cover certain specialized areas of our SBID Program, our staff is augmented by researchers from the academic community on a subcontractor or consultant basis. This has strengthened our relationships with several universities and various Government laboratories.

The company, as a whole, employs approximately 40 Ph.D. level professionals. Their specialties span a broad spectrum of disciplines in the physical sciences and in the humanities.

In the 1960's, scientists conducted research for the sake of doing research, but today, I might point out that many good researchers are highly motivated to get their work into commercial development. The SBID Program is a means for a small business to accomplish this.

We think that the SBID Program is necessary to give small business a stake in the emerging technologies of the future, and I believe the SBID Act will have a major impact on the new technologies of tomorrow.

Mr. Chairman, Dr. Peter Pronko, who is not only a better speaker than I, but equally good looking, chief scientist of UES Materials Research, will cover phase II and phase III of our SBID awards and talk about the program.

Mr. **Mavroules**. Thank you very much. Dr. Pronko?

Mr. **Pronko**. My name is Peter Pronko. I am chief scientist with Universal Energy Systems.

In 1983, Universal Energy Systems was ranked first in Ohio and was part of a second place group in the Nation for winning small business innovative research awards.

During the last 3 years, we have executed R&D programs associated with 16 phase I SBID's and 2 phase II SBID's. These have been administered by the Department of Energy, the National Science Foundation and the Department of Defense.

The two phase II programs we have are in the area of high energy ion beam processing of material surfaces. The first of these, funded by the NSF, involves the use of ion beams to fabricate high-quality laser mirror surfaces. The second, funded by the Department of Energy, is associated with the use of ion beams to fabricate corrosion resistant coatings on precision metal parts. These programs are a consequence, or recognition, of the fact that materials engineers are requiring new innovation on surface properties of materials. Our activities are in response to that demand by the engineering community.

One example of the products that we are attempting to develop is an ultra smooth laser mirror, for example, which would be used in highly efficient lasers.

As part of our SBID phase III efforts, UES is now in a stage of developing a spinoff business associated with commercial ion beam processing to carry this new technology into the marketplace. This would be accomplished through a combination of investments by UES, its employees, and third party investors.

We have been impressed with the administration of the SBID Program. Some points to be made concerning it are the following.

First, it is an extremely well run program with dedicated administrators and exists in spite of some early bureacratic opposition to the program.

Second, we have found that the program administrators respect and respond favorably to good ideas and well executed research.

Third, we have received valued feedback from administrators and technical program monitors.

Fourth, the SBID Program allowed UES to penetrate otherwise closed governmental funding agencies through the phase I proposal process.

Without the SBID Program we would have never had the opportunity to work with the Department of Defense in certain areas and to demonstrate our expertise in those areas.

We have some suggestions for the future. First, continue to develop the SBID Program both conceptually and substantially and increase its scope.

Second, increase the number of mechanisms to assist in developing phase III opportunities, for example, ways of handling marketing costs and developing business plans. These are activities that are not particularly simple for technical and scientific people to do.

Third, continue to protect the program from big business and big university interest. There is a value in smallness, and I would like to respond to some of Mr. Cooper's earlier questions, if I may later.

Fourth, the phase I seed money almost never covers phase I expenses. That has been our experience. Cost sharing by the recipient company should be assumed. We always end up putting more money into the phase I Program than we actually get from the phase I.

The fifth point, phase II proposals must be written early in the phase I effort to avoid a gap in the funding. More often than not, this is too early to intelligently write a Phase II Program.

Therefore, we would suggest that a contract be available for both phase I and phase II with only phase I being initially funded. Phase II funding will follow at the option of the funding agency depending on the activity. This is, in part, now covered by the so-called interim funding sequence, which needs additional study and additional development. The interim funding is very important, but is not always implemented by the agencies.

In conclusion, the SBID Program sponsors technical excellence which can transition into the commercial arena. This is the first opportunity that many researchers have ever had to make an impact on the commercial world and to contribute to the economic growth of the country.

As pointed out earlier in the testimony, a study by Gelman Associates reports that on the average small firms produce 2½ times more innovation per employee than larger firms and commercialize these innovations 1 year faster and at 25 percent of the cost.

The bottomline is that 1 percent of the total Federal R&D budget is a small price to pay for a much larger contribution to the technological base of our country.

It has been a pleasure to address this committee today, and I thank you for the opportunity to discuss the SBID Program.

[Dr. Joshi and Dr. Pronko's prepared statement, with attachments, follows:]

PREPARED STATEMENT OF DR. KRISHAN K. JOSHI, PRESIDENT, AND DR. PETER P. PRONKO, CHIEF SCIENTIST, UNIVERSAL ENERGY SYSTEMS, INC.

It is a pleasure to address this committee today. As representatives of Universal Energy Systems, in Dayton, Ohio, we are pleased to have an opportunity to discuss the Small Business Innovative Research program and our experience with it.

UES is a high-tech which provides research and development services to industrial and government clients. We employ approximately 120 people, 10 of whom are funded by the SBIR program. Our total corporate revenues for FY-84 were $6.5 million and are expected to approach $9.5 million in FY-85. Approximately one half of the company's resources are committed to the physical sciences. To support this commitment, UES corporate executives have made a major investment of approximately 2 million dollars in a modern, state-of-the-art Materials Research Laboratory. Advanced research in solid state physics, metallurgy, and ceramics is conducted within this facility.

For Universal Energy Systems, an 8(a) small business, the SBIR program has been a dynamic tool which we have used to foster new technology for the Research and Development community and for the commercial marketplace. We feel that the technology we are developing through the program has already had an impact on our immediate economic area and that it will eventually impact the nation.

The impact of the SBIR program on UES has been extensive.

- The SBIR program has been a key factor in supporting the growth of our in-house laboratory, our Materials Research programs and personnel.
- The SBIR program has alerted us to various research & development opportunities and has streamlined the submittal of unsolicited research ideas to the appropriate government agencies.

- The program has helped us to improve our marketing efforts by providing access to information concerning potential program requirements, agencies, and customers not available elsewhere.
- To take advantage of the opportunity of commercialization of Phase III SBIR programs, we have begun to build a small network of interested investors to provide capital for this development.
- With the SBIR program, we not only have maintained our staff of eminently qualified personnel, but we have been able to attract additional high-tech employees.
- To cover certain specialized areas of our SBIR programs, our staff is augmented by researchers from the academic community on a sub-contractor or consultant basis. This has strengthened our relationships with several universities and various government laboratories.

This program was attacked early in its life on the basis that there was a lack of qualified researchers in the small business community and that the quality of the proposals would somehow be inferior. Government agency evaluators have indicated that this has not been the case in the area of the physical sciences. It certainly is not the case at UES. The company, as a whole, employs approximately 40 Ph.D. level professionals. Their specialties span a broad spectrum of disciplines in the physical sciences and in the humanities. It should be pointed out that many good researchers are highly motivated to get their work into commercial development and the SBIR program is the means to accomplish this. We think that the SBIR program is necessary to give small business a stake in the emerging technologies of the future.

In 1983, Universal Energy Systems was ranked first in Ohio and second in the Nation for winning Small Business Innovative Research awards. During the last 4 years we have executed R&D programs associated with 16 Phase I SBIR's and 2 Phase II SBIR's. These have been administered through the Department of Energy, the National Science Foundation, and the Department of Defense.

The two Phase II programs we have are in the area of high energy ion beam processing of material surfaces. The first, funded by the NSF, involves the use of ion beams to fabricate high quality laser mirror surfaces. The second, funded by the DoE, is associated with the use of ion beams to fabricate corrosion resistant coatings on precision metal parts.

As part of our SBIR Phase III efforts, UES is now in the stage of developing a spin off business associated with commercial ion beam processing to carry this new technology into the marketplace. We foresee the start-up of a new company whose task it would be to carry this technology into the industrial sector as well. This will be accomplished through a combination of UES, employee, and third party investments.

The SBIR program was brought into its expanded form shortly after our research facility was operational. It became immediately apparent that this program was ideally designed for us. We aggressively submitted a substantial number of proposals since UES possessed the following capabilities:

- Our research facility was already in place.
- We had an established technical and support staff.
- We had well targeted research ideas.
- We employed well qualified professionals to define, write, and execute proposals.

- We had a strong desire to carry research through the development stage to commercialization.

We are impressed with the administration of the SBIR Program.

- It is an extremely well run program with dedicated administrators and it exists in spite of some early bureaucratic opposition to the program.
- We have found that the administration respects and responds favorably to good ideas and well executed research.
- We have received valuable feedback from administrators and technical program monitors.
- The SBIR Program allowed UES to penetrate "closed" DoD organizations with Phase I proposals which contributed to the DoD's mission. Without the SBIR program, we would have never had the opportunity to work with certain customers and demonstrate our expertise. In many cases, the DoD considers itself to be the Phase III customer.

Suggestions for the Future:

- Continue to develop the SBIR program both conceptually and substantially and increase its scope.
- Increase the number of mechanisms to assist in developing Phase III opportunities.
- Continue to protect the program from big business and big university interests.
- The Phase I seed money almost never covers Phase I expenses. Cost sharing should be assumed.

- Phase II proposals must be written early in the Phase I effort to avoid a "gap" in the funding. More often than not, this is too early to intelligently write a Phase II program. We would suggest that a contract be written for both Phase I and Phase II with only Phase I being funded. Phase II funding would follow at the appropriate time.

In conclusion, the SBIR program sponsors technical excellence which can transition into the commercial arena. This is the first opportunity that many researchers have ever had to make an impact on the commercial world and to contribute to the economic growth of their nation. A study by Gellman Associates reports that, on the average, small firms produce 2.5 times more innovations per employee than larger firms and commercialize these innovations one year faster and at 25% the cost.

The bottom line is that 1% of the total Federal R&D budget is a small price to pay for a much larger contribution to the technological base of our country.

It was a pleasure to address this committee today. Thank you for the opportunity to discuss the SBIR program and our rewarding experience with it.

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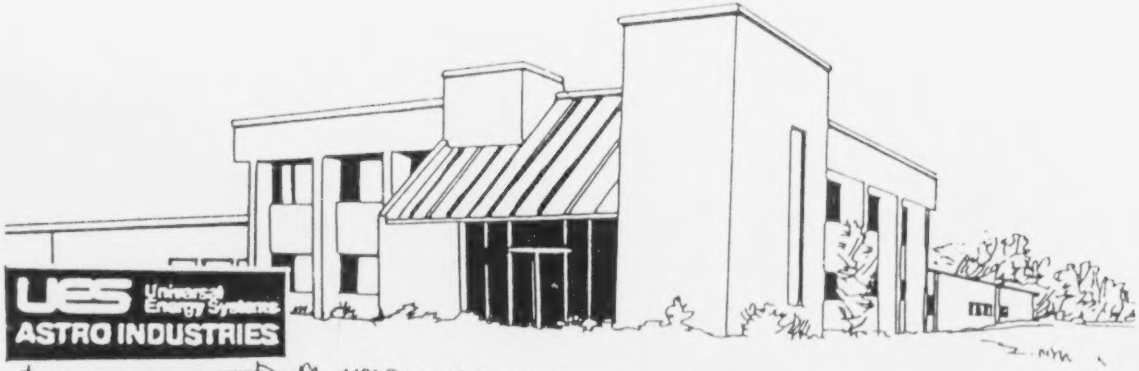
UES UNIVERSAL
ENERGY SYSTEMS INC.


UES Universal Energy Systems
ASTRO INDUSTRIES

4401 Dayton-Xenia Rd · Dayton, Ohio 45432 · phone 513/426-6900 ·
· Cable: ENERGY · Telex 288250

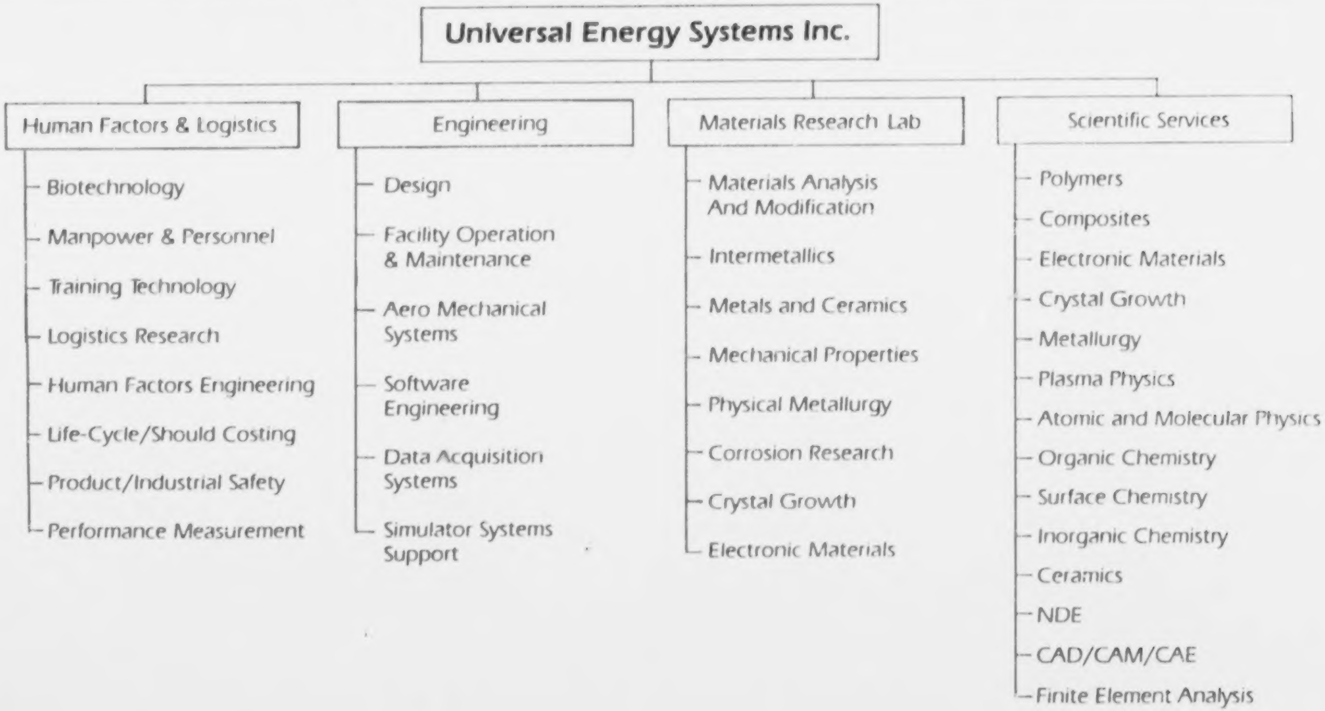
UES

Who We Are

- **UES is a High Technology Company Dedicated to Innovative and Creative R&D in Engineering and Science**
- 10+ Years Successful R&D for Government and Industry
- Top People and Sound Management
- Small Business (100 Full Time, 50 Part Time, ~ 40 PhDs) Qualified 8a.
- Cleared to Secret
- \$3,500,000 Investment in Equipment and Facilities
- Corporate Office in Dayton, Ohio (37,000 ft^2)

UES

What We Do



Universal Energy Systems Inc.

Human Factors & Logistics

- Biotechnology
- Manpower & Personnel
- Training Technology
- Logistics Research
- Human Factors Engineering
- Life-Cycle/Should Costing
- Product/Industrial Safety
- Performance Measurement

Engineering

- Design
- Facility Operation & Maintenance
- Aero Mechanical Systems
- Software Engineering
- Data Acquisition Systems
- Simulator Systems Support

Materials Research Lab

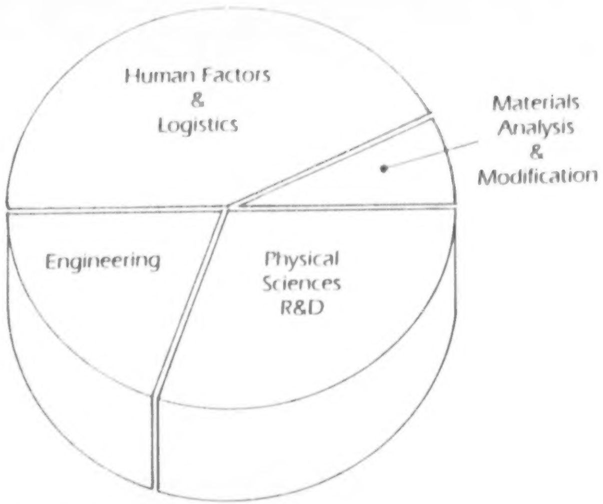
- Materials Analysis And Modification
- Intermetallics
- Metals and Ceramics
- Mechanical Properties
- Physical Metallurgy
- Corrosion Research
- Crystal Growth
- Electronic Materials

Scientific Services

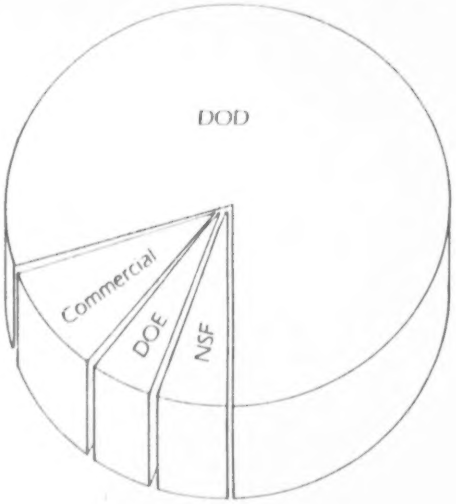
- Polymers
- Composites
- Electronic Materials
- Crystal Growth
- Metallurgy
- Plasma Physics
- Atomic and Molecular Physics
- Organic Chemistry
- Surface Chemistry
- Inorganic Chemistry
- Ceramics
- NDE
- CAD/CAM/CAE
- Finite Element Analysis

UES

Client and Capability Distribution



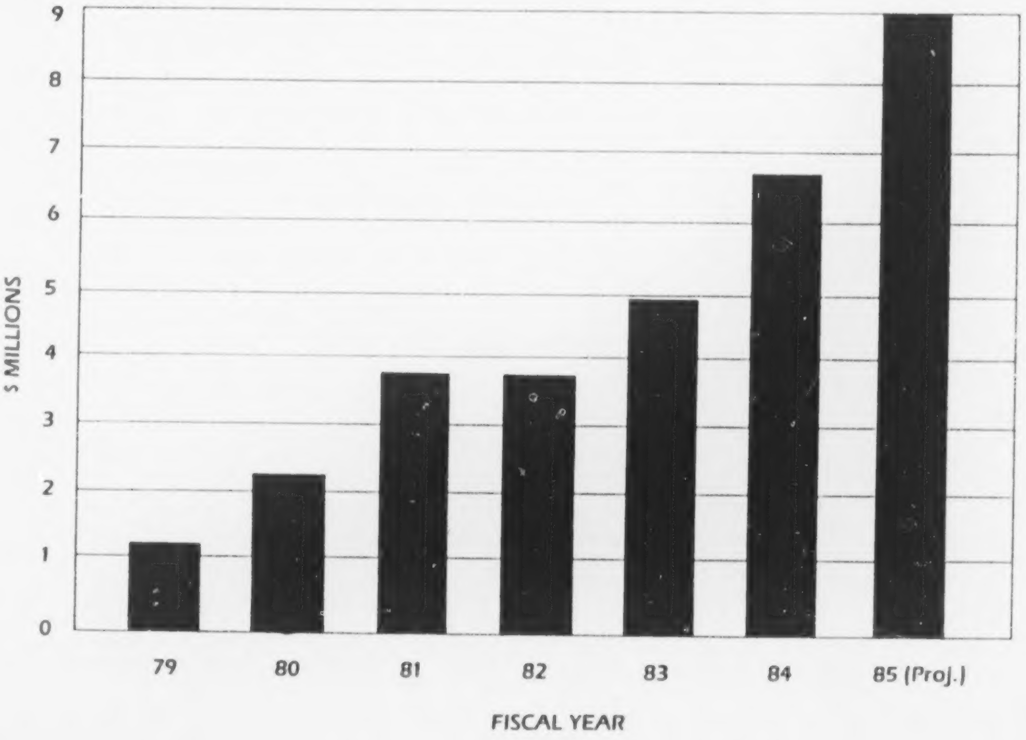
Type of Business



Our Clients

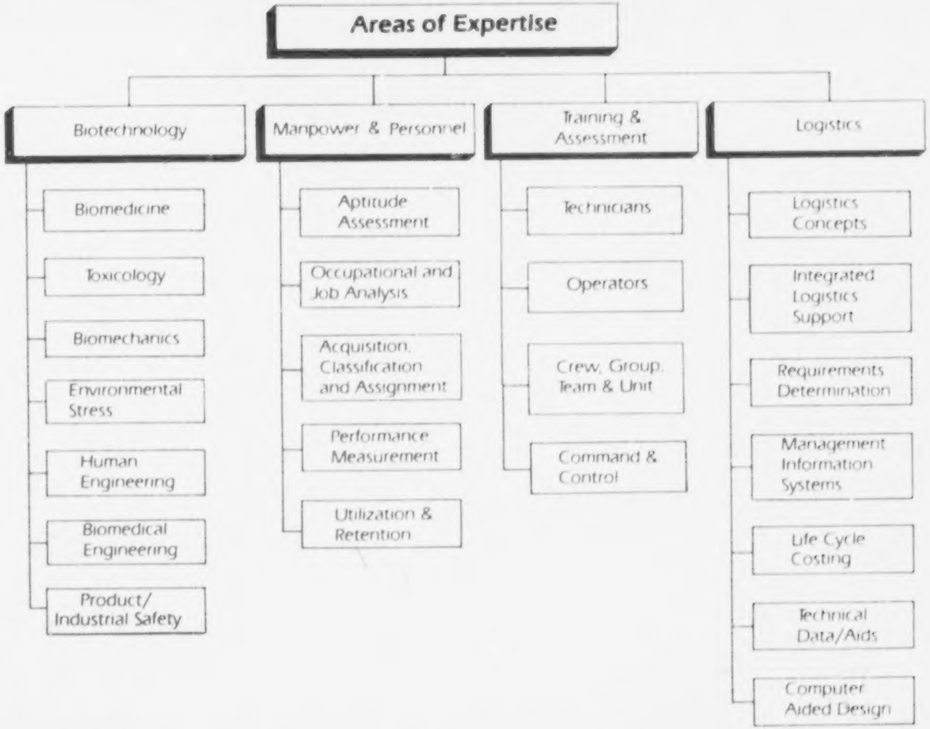
UES

Corporate Growth



UES

Human Factors & Logistics

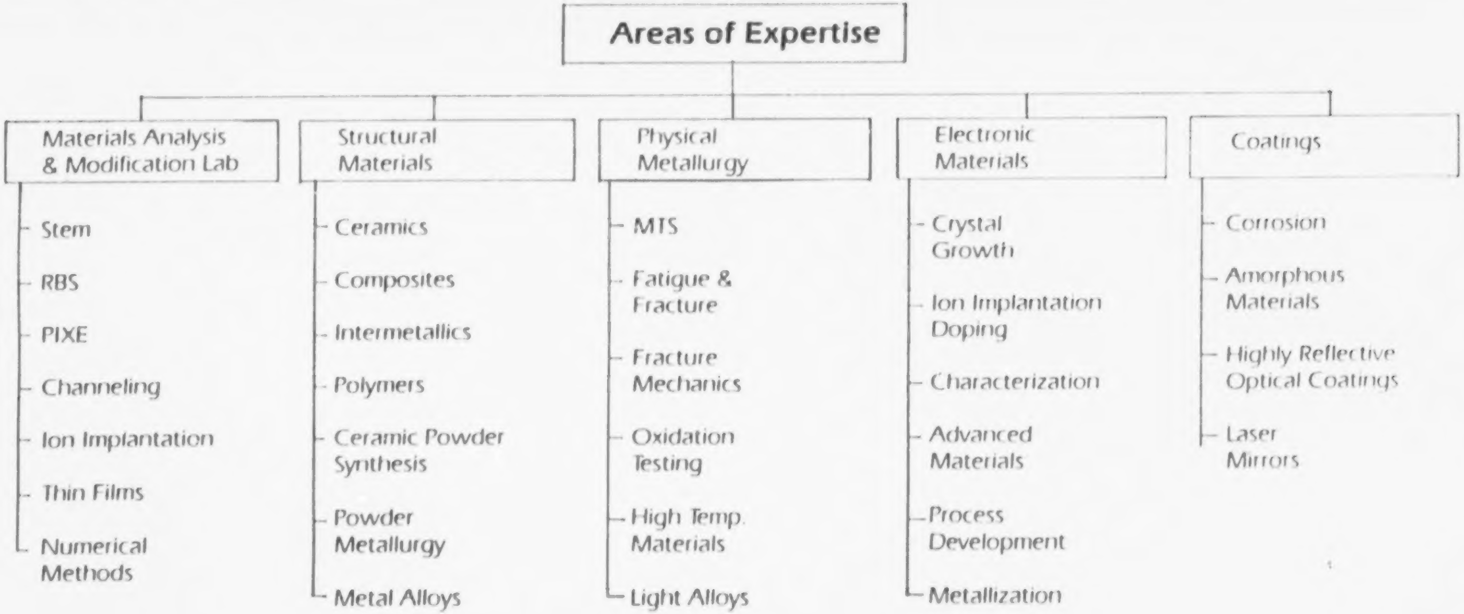


Areas of Expertise

- Biotechnology
  - Biomedicine
  - Toxicology
  - Biomechanics
  - Environmental Stress
  - Human Engineering
  - Biomedical Engineering
  - Product/ Industrial Safety
- Manpower & Personnel
  - Aptitude Assessment
  - Occupational and Job Analysis
  - Acquisition, Classification and Assignment
  - Performance Measurement
  - Utilization & Retention
- Training & Assessment
  - Technicians
  - Operators
  - Crew, Group, Team & Unit
  - Command & Control
- Logistics
  - Logistics Concepts
  - Integrated Logistics Support
  - Requirements Determination
  - Management Information Systems
  - Life Cycle Costing
  - Technical Data/Aids
  - Computer Aided Design

UES

Materials Research Lab



Areas of Expertise

- Materials Analysis & Modification Lab
  - Stem
  - RBS
  - PIXE
  - Channeling
  - Ion Implantation
  - Thin Films
  - Numerical Methods
- Structural Materials
  - Ceramics
  - Composites
  - Intermetallics
  - Polymers
  - Ceramic Powder Synthesis
  - Powder Metallurgy
  - Metal Alloys
- Physical Metallurgy
  - MTS
  - Fatigue & Fracture
  - Fracture Mechanics
  - Oxidation Testing
  - High Temp. Materials
  - Light Alloys
- Electronic Materials
  - Crystal Growth
  - Ion Implantation Doping
  - Characterization
  - Advanced Materials
  - Process Development
  - Metallization
- Coatings
  - Corrosion
  - Amorphous Materials
  - Highly Reflective Optical Coatings
  - Laser Mirrors

UES

Capabilities

Engineering Division

- Design
- Facility Operation & Maintenance
- Aero Mechanical Systems
- Software Engineering
- Data Acquisition Systems
- Simulator Systems Support

UES

Laboratory Capabilities

- High Energy Implants
- Surface Analysis, RBS, PIXIE, Hydrogen Depth Profiling
- Electron Microscopy
- Corrosion Testing and Evaluation
- MTS, Fracture Mechanics
- Crystal Growth

UES

Facilities and Equipment

- **Materials Modification & Analysis**
  - —1.7 MV General Ionex Tandetron Ion Accelerator
  - —Hitachi Scanning and Transmission Electron Microscope
  - —Materials Testing System
  - —Corrosion Research Apparatus
  - —Float Zone Crystal Growth System
  - —Thin Film Deposition System

- **Computational Facilities**
- **Electronics Laboratory**
- **Design/Drafting**
- **Machine Shop**
- **Graphics Shop**

UES

Why UES?

- Broad Experience/Perspective
- Full-Spectrum Capability
- National Network
- Management and Technical Personnel Understand the Customer
- Visibility of Project to Management
- Lean, Mean and Enthusiastic

THE CINCINNATI ENQUIRER

SUNDAY, JULY 15, 1984

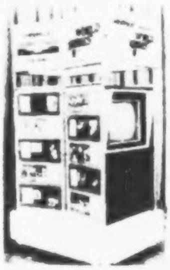
BUSINESS/REAL

EDITOR: ROBERT CLERC, 369-1009 THE CINCINNA

OUTLOOK

On Business Trends

The Region . . .



Eastgate Mall, following the trend in shopping mall events and capitalizing on local baseball fever, is hosting the second annual Chevrolet Traveling Baseball Hall of Fame Thursday through Sunday. The 14-part exhibit includes bats dating from the days when players made their own, heavy woolen and silky satin uniforms, a baseball from the mid-1800s and the experimental yellow ball of 1938. There are illustrations of all 184 Hall of Famers. A spokesperson will be on hand to answer questions.

■ ■ ■

Major conventions booked into the Cincinnati Convention/Exposition through the remainder of July include the Knights of St. John—Supreme Commandery (July 17-22), headquartered at the Clarion hotel with estimated attendance of 2,500, and the National Association of Miniature Enthusiasts (July 25-29), also headquartered at the Clarion with estimated attendance of 1,500.

■ ■ ■

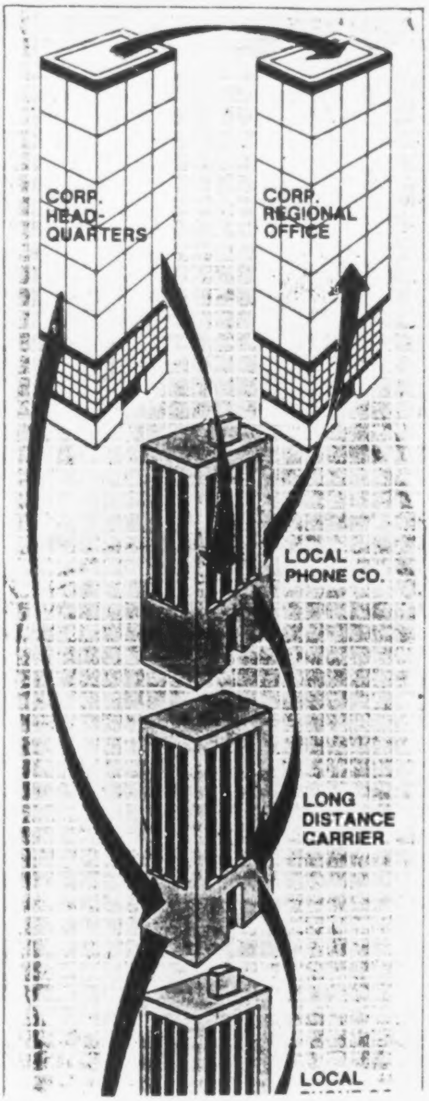
Dun & Bradstreet reports that the total value of building permits in Cincinnati increased 1.6% from 1962 to 1983, rising from $279.20 million to $283.56 million.

The State . . .

Ohio's technology-based small businesses won 30 grants in the first year of the highly competitive Federal Small Business Innovation Research program. That ranked the state fifth in the nation and won for the companies more than $1 million and the chance to compete for a second round of larger grants. Universal Energy Systems of Dayton won six of the 30 grants and Material Concepts of Columbus won four.

■ ■ ■

Ohio State University officials announced in late June that R. David Thomas, senior chairman of the board and founder of Wendy's International Inc., has made a personal gift worth more than $2.1 million to the OSU Cancer Research Institute.



BEAVERCREEK NEWS October 15, 1984

UES a leader in small business innovative research awards

Universal Energy Systems, Inc, a high technology research and development company located at 4401 Dayton-Xenia Rd, has won a total of 13 Small Business Innovative Research (SBIR) awards since the program was initiated by the government in 1982.

By winning these awards, UES ranks first in the State of Ohio and is one of the top ten recipients of SBIR awards in the nation.

ONE OF the award winning proposals, written by Dr Vasudevan Srinivasin, has been cited by the Small Business High Technology Institute as one of the best proposals presented to the SBIR program.

"UES is very pleased to have been awarded these contracts," states Bob Ferguson, Director of Business Development for the firm. "Since we have established a solid reputation for creative research with the programs we have conducted for the Air Force, the Navy, the Departments of Defense and Energy, the National Science Foundation, and many commercial firms, we think we have a good chance of receiving many more SBIR awards in the future."

The objective of the two year-old SBIR program is to increase the opportunity for small businesses working in the science and high technology areas to participate in government-funded research. Additionally, the program is designed to transfer research and development technology into government and industry applications eventually creating more job opportunities and advancement.

Universal Energy Systems

ABOUT UES

Founded in 1973, Universal Energy Systems is a high technology company dedicated to innovative and creative research in the physical, behavioral, and applied sciences. UES has a comprehensive capability to address a full spectrum of scientific and engineering research and development problems.

UES utilizes a multi-disciplinary approach to solve technical problems for both government and industrial customers. To provide quality research and development, UES maintains a staff with outstanding capabilities in electrical, electronic, mechanical, aeronautical and industrial engineering; materials and chemical sciences; and human factors and logistics technologies. These key personnel are supplemented by a support staff in the areas of design, software, instrumentation, and fabrication. The company's strength lies in the ideas, capabilities, and achievements of its highly qualified engineers, scientists, and technical staff. Their areas of expertise and level of education are shown in Fig. 1.

ABOUT MAML

The UES Materials Analysis and Modification Laboratory (MAML) was formed in 1981 to solve material problems through analysis, testing, and modification of the near surface layers of materials. The primary tools available in this facility are a megavolt ion accelerator providing a variety of ion species, energies, and applications and an electron microscope featuring state of the art analytical capabilities. The MAML can be understood best by learning about the people, techniques, and equipment involved in it.

Personnel Resources

The personnel resources of the UES Materials Analysis and Modification Laboratory involve three types of people: Staff Scientists, Contributive Researchers, and Support Personnel.

Staff Scientists
Approximately 20 full-time materials scientists and physicist's are engaged in sponsored materials research programs, both directly within and adjunctive to the laboratory.

Contributive Researchers
Many exceptional researchers from educational and industrial organizations supplement the permanent UES staff on materials research programs. Over 40 such contributive researchers have been engaged on sponsored UES research programs during the past year. The use of such individuals is an extremely cost effective approach to solving special problems.

Staff Support Personnel
Full-time technicians and clerical personnel provide efficient support in the operation of laboratory facilities and preparation of technical documentation.

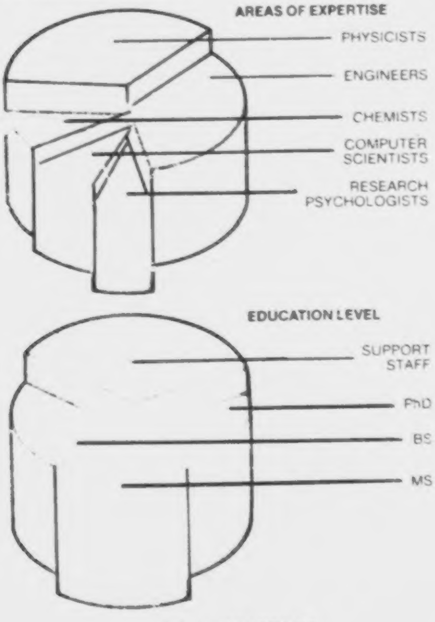


FIG. 1 UES AREA OF
EXPERTISE & EDUCATIONAL LEVEL

Materials Analysis Techniques using Ion Beams

The UES Material Analysis and Modification Laboratory offers a unique capability in the application of several techniques associated with the analysis and modification of materials.

Ion Scattering Analysis
Analysis of the number and energy of ions scattered from a solid by the Rutherford elastic scattering process can provide a non-destructive, quantitative, mass specific depth profile of the first few microns of the material. These capabilities are illustrated in Fig. 2 for 2.0 Mev He ions scattered from a silicon crystal implanted with Sb atoms.

- Since the energy of the scattered He depends on the mass of the scattering atom, separate energy spectra are obtained from the Si host and the embedded Sb impurity. (Mass specificity)
- Because the He energy loss processes are well known, the scattered ion energy can be converted into separate depth profiles as shown. (Depth sensitivity)
- Since the Rutherford scattering process is quantitative, the number of ions scattered from Si or Sb is directly proportional to the concentration of atoms at that depth. (Quantitative)

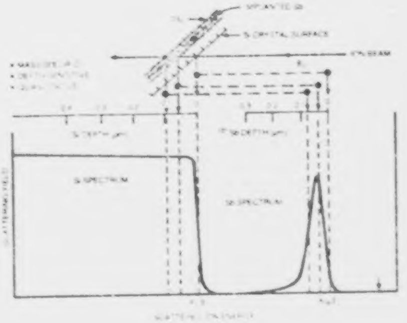


FIG. 2 RBS ION SCATTERING ANALYSIS

Materials Analysis Techniques using Ion Beams

Positive Ion Channeling Spectroscopy

When the host target is a single crystal oriented with the He ion beam parallel to a major axis or plane, the ions can be steered by the symmetrically arranged atoms (ion channeling effect) and the scattered ion energy spectra become altered to provide valuable, additional information. This is illustrated in Fig. 3 for analysis of an ion implanted and pulsed laser annealed silicon single crystal.

As a consequence of the ion channeling effect, the scattered ion energy distribution from an unimplanted sample (Fig. 3a) changes from that shown by the upper dashed curve (characteristic of amorphous Si) to that shown by the lower curve (oriented single crystal) labeled virgin Si. This tremendous reduction in scattered ion yield provides a special sensitivity to the Si surface atoms (note the Si peak at zero depth) and reduces the background scattering at large depth.

The measurement is sensitive to surface oxides (note peak labeled ^{16}O) or other surface contaminants. Since the channeling effect exists because of the crystal perfection, it is a sensitive monitor of disorder in the Si crystal and the lattice location of implanted impurities. This is shown by the channeling spectra in Fig. 3a taken from a Si crystal implanted with As (upper solid curve) and after annealing (Fig. 3b) with a single laser pulse. The first curve shows that as a result of As ion implantation damage, the Si crystal has become amorphous to depths of ~0.15 μm and the As is located in this amorphous region. After annealing (Fig. 3b) the Si spectrum is almost identical to a virgin crystal signifying complete epitaxial recrystallization, and the As spectrum now shows complete incorporation of As atoms into substitutional (electrically active) lattice sites.

The combination of ion scattering/channeling can be utilized for surface and radiation damage studies, lattice location, diffusion or annealing studies and much more. One can also combine nuclear reactions or x-rays, as discussed below, with ion channeling.

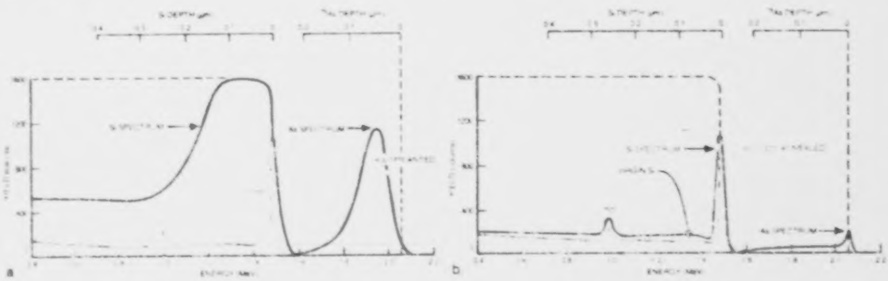


FIG. 3. CHANNELING AND BACKSCATTERING ANALYSIS

Materials Analysis Techniques using Ion Beams

Nuclear Reaction Analysis (NRA)

For certain ion-atom combinations nuclear reactions can occur which emit ions and/or gamma rays as reaction products. Since these reactions occur with known probability at definite resonant energies, one can obtain a quantitative depth profile by monitoring the yield of the reaction product while increasing the bombarding ion energy to cause the resonant reaction to occur at increasing depths into the target. Since the UES accelerator can produce many different ions at a variety of energies, a wide range of impurities can be detected by NRA.

A typical application is shown in Fig. 4 where the $^{1}H(^{15}N, \alpha\gamma)^{12}C$ and $^{1}H(^{19}F, \alpha\gamma)^{16}O$ reactions have been used to profile e concentration of H incor- ̲rated into an amorphous Si sample during the deposition process. By increasing the energy of the ^{15}N or ^{19}F bombarding ions in a stepwise fashion the sharp resonance occurs at increasing depths into the Si. A measurement of the γ-ray yield at each energy gives a quantitative determination of the hydrogen concentration at that depth. Unlike many analysis techniques, NRA is quantitative, detects hydrogen in any chemical form and does not destroy the sample as a consequence of analysis. It can also be applied to detect many other species in addition to hydrogen.

Ion Induced Characteristic X-Rays

Energetic H or He ions also can be utilized to excite x-rays by ionizing collisions with the atoms in a target. Since the x-ray energies are characteristic of the target atom, this is yet another quantitative, nondestructive, mass-specific ion beam analysis technique. This method is accurate and highly sensitive due to the high atomic cross sections for inner shell vacancy production and the x-ray energy dependence on atomic number.

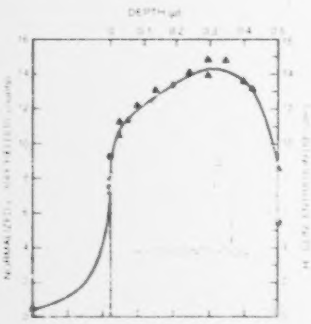


FIG. 4 CONCENTRATION OF HYDROGEN Vs DEPTH IN AN AMORPHOUS Si SAMPLE THROUGH ION-INDUCED γ-RAY ANALYSIS

Materials Analysis Techniques using Electron Microscopy

Electron microscopy provides structural and crystallographic information on materials.

TEM Structural Analysis

Through appropriate tilting procedures (±60°) one can obtain analyses of diffraction patterns in different orientations, resulting in determinations of crystalline structures. As an example Fig. 5a shows the electron diffraction pattern in a <114> orientation on an <001> ion-implanted and annealed GaAs sample. Structural twinning is found to occur with the presence of extra spots at 1/3<115> and 2/3 <115> indicating clearly that the twins lie on {111} planes. In addition to tilting the specimen, one can also tilt the incident electron beam using the beam deflector. The built-in condenser stigmator and brightness control permit instantaneous switching of bright and dark field images. With the possibility of a ±4° beam tilt at 100 KeV, one obtains information as in Fig. 5b showing a conventional dark field (CDF) micrograph.

FIG. 5 TEM STRUCTURAL ANALYSIS

Materials Analysis Techniques using Electron Microscopy

TEM Precipitate Analysis

Analysis of precipitates can be done by operating the microscope in its selected area diffraction mode in combination with bright and dark field capabilities. Fig. 6 is an example of the observation of Cr precipitates in Cr-implanted GaAs. Fig. 6 (a,b,c) are the (a) bright field, (b) dark field and (c) selected area diffraction pattern. The dark field picture is formed by tilting the electron beam so that the objective aperture allows only those electrons through that are responsible for the first diffraction ring from chromium.

FIG. 6. TEM PRECIPITATE ANALYSIS

TEM Defect Analysis

High resolution weak beam dark field images (g / 3g) can also be made by tilting the electron beam. This technique is extremely useful for studying very small defects (≤100A°). Fig. 7a shows a weak beam dark field micrograph of such small defects in annealed ion-implanted GaAs. Additionally, under dynamical black-white diffraction contrast (Fig. 7b), the nature of these small defect clusters can be determined.

SEM and STEM Mode

Scanning electron microscopy (SEM) is a valuable tool for analysis of surface morphology. SEM can easily be accomplished with the UES instrumentation since the same specimen area may be examined in the TEM, STEM, SEM or EDX modes at a touch of the push button controls. It is possible to tilt the specimen from 0 through ±60° for SEM, STEM, and TEM without losing the field of interest. (In μ diffraction, the tilt is ± 25°.)

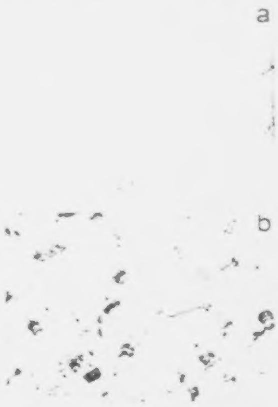


FIG. 7. TEM DEFECT ANALYSIS

Materials Modification Techniques

important and innovative techniques in materials modification such as ion implantation doping and ion beam mixing are within the scope of UES capabilities.

Ion Implantation Doping

Ion implantation is a non-equilibrium technique capable of introducing impurities into the near surface region of solids. It is independent of many of the normal materials preparation constraints such as solid solubility, diffusion coefficients and surface permeation effects. Consequently, this method frequently leads to new and often unique materials properties. Since the ions are mass and energy selected, it is possible to implant any desired species, even any isotope, with certainty. The energy of the bombarding beam can be controlled to tailor the depth distribution of the implanted species. Current integration provides accurate doping concentrations, and raster scanning insures lateral uniformity. The UES facilities are capable of implantations of a wide range of ions with energies from 200 keV to 6 MeV. The high energy heavy ion implantation capability is particularly suited for fundamental research investigations and many practical applications such as modification of friction, wear and corrosion in metals, and deep implants for semiconductors.

Production Oriented Implantation

High energy ion implantation is an emerging field in research and development of new semiconductor devices. Universal Energy Systems has the capability to provide service implantation as well as research in this important discipline. UES is currently conducting sponsored programs in this area and other innovative applications are invited.

The high energy implantation facility uses a cesium negative ion sputter source to produce beams in the hundred micro-ampere range. These beams are mass analyzed, electrostatically accelerated, focused, selected for charge state and raster scanned over areas on the order of three inch diameter (Fig. 8) with final particle beam intensities in the few to tens of micro-ampere range (e.g. Ni^{++} at 65 μamps, B^{++} at 10 μamps). Beams of this intensity can be conveniently used for p-type and n-type doping in semiconductors at fluence levels in the 10^{11} to 10^{14} cm^{-2} range involving implantation times of fractions of seconds to a few minutes. These procedures have interesting possibilities for the production of buried layers where anneal temperatures must be kept below typical solid state diffusion temperatures. Implantation through thick resist material and other overlayers could also have important applications with this method.

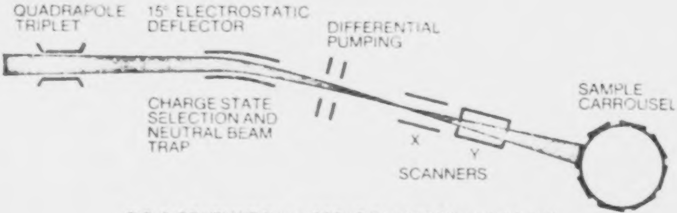
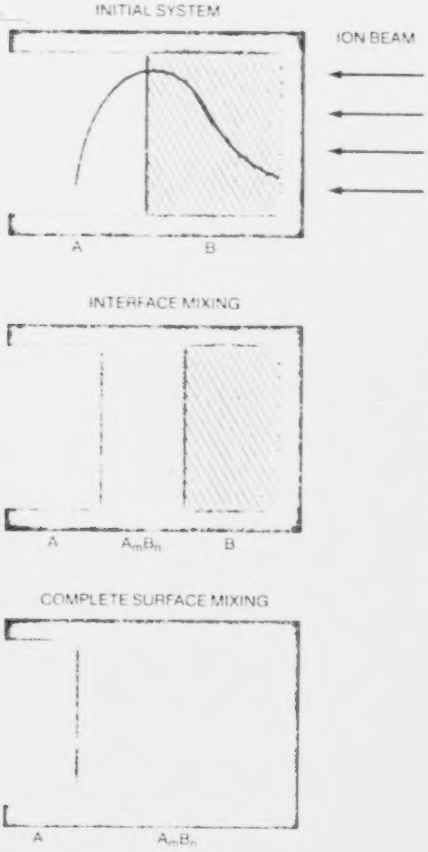

QUADRAPOLE TRIPLET
15° ELECTROSTATIC DEFLECTOR
DIFFERENTIAL PUMPING
SAMPLE CARROUSEL
CHARGE STATE SELECTION AND NEUTRAL BEAM TRAP
X
Y
SCANNERS

FIG. 8 SCHEMATIC ILLUSTRATION OF BEAM HANDLING FOR HIGH ENERGY IMPLANATION

Ion Beam Mixing

Heavy ion bombardment of thin film composite materials can be an extremely efficient process for inducing materials interactions. This phenomenon, called ion beam mixing, is represented schematically in Fig. 9. When a thin film of B deposited on substrate A is bombarded with energetic heavy ions, defects are produced and the two materials can intermix by defect interactions, radiation enhanced diffusion, and ballistic mixing. Once mixed, materials interactions can occur in each individual ion cascade volume. Because of the extremely short lifetimes of these ion damage cascades (~10^{-11}—10^{-13}s), the interacting atoms experience an extremely rapid quench. These combined effects have been utilized to induce materials properties ranging from stable compounds to new surface alloys not achievable by other processing techniques.

In order to be effective the bombarding heavy ions must penetrate the interface between the two materials. The high energy heavy ion capabilities of the UES facilities offer a wide range of possibilities for exploiting this new processing technology. Possible applications include fabrication of superconducting thin films, metal/semiconductor contacts, metal/ceramic bonding, metallization of machined parts for friction or corrosion resistance, and many more.



CONTRIBUTING EFFECTS

- DEFECT PRODUCTION
- DEFECT INTERACTIONS

- RECOIL IMPLANTATION
- CASCADE MIXING
- RADIATION ENHANCED DIFFUSION

- CASCADE QUENCHING
- THERMAL SPIKES
- INTERFACE ACTIVATION
- CHEMISTRY - METALLURGY

FIG. 9 ION BEAM MIXING

Laboratory Facilities and Equipment

The UES Materials Analysis and Modification Laboratory utilizes two major items of equipment (a Tandetron™ Ion Beam Accelerator and a Hitachi H-600 Scanning Transmission Electron Microscope) and various support facilities.

Ion Beam Accelerator

Accelerated ion beams provide a new concept for the analysis of materials and for processing the surface of materials to achieve useful properties. The approach selected by UES offers maximum versatility in order to exploit these important emerging technologies to the fullest. The nucleus of the UES ion beam facilities is the Tandetron™ accelerator manufactured by General Ionex. It consists of the following components:

Negative Ion Injectors

- Duoplasmatron source for production of H beams up to 3.4 MeV and He beams up to 5.1 MeV
- High Intensity Negative Ion Sputter Source for production of heavy ions such as Ni, Cu, Fe, Al, B etc. with energies in the range $0.2 \leq E \leq 6$ MeV
- Magnetic analysis of injected beams for isotopic selection and maximum current

2. Accelerator System

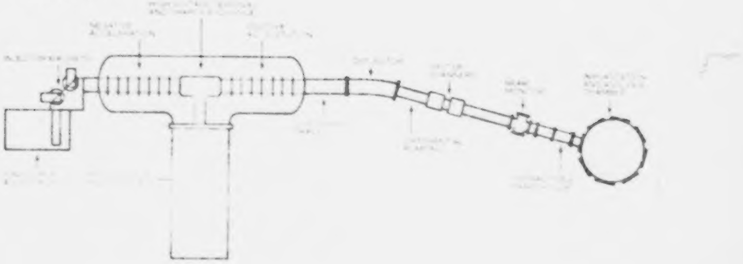
- 1.7 MV Tandetron™ accelerator specified as a dedicated instrument for solid state and materials research
- Energies E available for ions stripped to charge state Q at the terminal with potential V on terminal are

$$E = (Q+1)V$$

- A low energy capability allows the Tandetron™ to operate to as low as V=100 kV for lower energy implantation and processing

3. High Energy Analysis Station

- Post acceleration mass and charge analysis
- Optimized ion optics
- Raster scanning for implantation beam uniformity
- Laser alignment for positional identification
- Ion Scattering Analysis
- Ion Induced Characteristic X-Rays
- Nuclear Reaction Analysis
- Positive Ion Channeling Spectroscopy
- Ion Implantation Doping
- Ion Beam Mixing



Laboratory Facilities and Equipment

Electron Microscope

The Hitachi H-600 Scanning Transmission Electron Microscope (STEM) is an analytical instrument of outstanding quality and versatility. This unit is capable of performing as a research tool or in routine analysis. Although its basic design is as an analytical instrument, it produces micrograph images and electron diffraction data with extreme ease and reliability. The H-600 STEM constitutes, therefore, an important basic part of the UES materials analysis capability.

Support Facilities

In addition to the above equipment, the laboratory facility is comprised of engineering design, darkroom, clean room, sample preparation, computer and electronics shops. The machining areas contain work space and extensive fabrication and [illegible] equipment.

Universal Energy Systems has equipped its laboratory with new state-of-the-art instrumentation. The laboratory is staffed with gifted professionals who are fully versed in both standard and innovative analysis techniques and ion beam-solid interaction phenomena, and who have established a reputation as problem solvers for the United States Department of Defense.

Mr. MAVROULES. Thank you, Dr. Pronko. The next witness is Dr. Saluja.

TESTIMONY OF DR. JACK SALUJA, VIKING ENERGY CORP., PITTSBURGH, PA

Mr. SALUJA. Thank you, Mr. Chairman, and members of the subcommittee. Viking Energy Corp., unlike UES, is a very small firm. We have a total of ten people, three of them devoted fully to the SBID or SBIR Program. So one-third of our total revenue comes from the SBIR Program.

We have over the years engaged in alternate energy programs and also nuclear safety in nuclear powerplants. I come from a background in the nuclear field, but in the last 6 years, we have worked in fields ranging from biomass, solar photovoltaics and coal technology, and still we continue to be where we are.

With regard to the SBID Program, our SBID project has to do with applications of robotics for use in the management of nuclear waste, at West Valley demonstration project.

Of course, there are a lot of large companies, like Westinghouse (Unimations), in this country, Cincinnati Milicron, who are involved in the area of robotics, but as some of them have pointed out earlier, they are interested in development of robotics when they can sell thousands of robots. They are not interested in the robotics for one of a kind unit, and that is where some of the small companies come into play.

With regard to getting an outside capital, we have not as yet approached outside people; that is, venture capital people. However, we think if we do, since we are an 8(a) firm, and under this 8(a) program, we cannot lose our 8(a) status, it will not be proper. We will have to relinquish the 8(a) status if we went about doing that, as it is required under this program to hold at least 51 percent of the stock in the company.

With regard to present and future applications of the research, we are at a stage where we were asked to complete the Phase II Program in a 1-year time frame rather than the normal 2 years that we would have liked to have, because it did not fit in with the decommissioning plans of the West Valley demonstration project.

So we went ahead at an accelerated pace to work on the second phase to meet the schedules of decommissioning with the result that we finished the demonstration of a robot that is remotely operated within a year, only to find out that the schedule has now slipped by almost 6 to 8 months, and most of the money for phase II is almost spent.

At this stage, we would like to commercialize; however, phase II is the demonstration which we have been able to do, and demonstration here implies doing surveying work with this remotely operated machine with an industrial robotic arm, doing visual surveys, doing surveys by taking instrumentation into the highly radioactive areas. In addition it performs remote vacuuming chores and the pickup and placing of objects. However, there are other things that still need to be done, mainly remotely scrubbing the floors of the contaminated area, cutting the pipes or screwing or unscrewing of the screws, nuts and bolts. Those types of things still need to be done to make it commercially viable.

At this stage, we are faced to almost coming to an end. I am trying hard to find other sources of money so that we can, one, retain the people, the additional three people that we have, but additionally pursue these other areas which would make it more versatile of a machine to use.

Mr. **Mavroules**. Thank you very much, Doctor.

[Mr. Saluja's prepared statement follows:]

Prepared Statement of Dr. Jack Saluja, Viking Energy Corporation, Pittsburgh, PA

WHAT HAS SBIR DONE FOR VEC?

1. In the execution of Phase 1 of the project, one technical person was added to the staff. In Phase 2, two and one-half additional people were added, and local fabrication shops were also made use of.

2. We have not seriously gone after outside venture capital as VEC is an 8(a) certified firm and, to maintain this certification, the stock of the CEO of the company cannot be diluted below 50%. We have also not been approached by anyone to-date.

3. The nuclear power utilities and nuclear facilities have only recently begun to look into the use of robot systems for work in hazardous environments to reduce occupational radiation exposures. They have yet to specify their needs and go after such systems. It seems we are a little ahead of our time, but a definite market exists in the future.

   Other markets as yet not explored are the hazardous environment of the chemical industry, and utilization of robot systems in the handling of explosive materials.

4. If Viking Energy had not received this SBIR contract, it would not have been able to afford, on its own, to carry on this project.

5. Viking Energy Corporation has only 10 employes, and one-third are involved on the SBIR project. We are one of the 3 minority companies, out of 104 companies, to be awarded a Phase I contract and, to my knowledge, the first of nearly 50 in Phase 2 to have completed the Phase 2 project. There are still many improvements that could be made to the system to make it more versatile and attractive to the customer, but we have already run out of funds. It would be a shame to lose the capabilities we have been able to assemble.

SMALL BUSINESS INNOVATION RESEARCH PROJECT

PHASE 1: IDENTIFICATION OF POTENTIAL ROBOTIC APPLICATIONS IN THE MANAGEMENT OF RADIOACTIVE WASTES AT THE WEST VALLEY DEMONSTRATION PROJECT

Client:
U.S. Department of Energy
West Valley Demonstration Project Office
P.O. Box 191
West Valley, NY 14171

Project Officer: Robert E. Stiens Telephone: (716) 942-3235

Abstract:

An exploratory study was made of a Nuclear Waste Facility, specifically that of the West Valley High Level Radioactive Waste Facility, in order to identify phases of construction and decommissioning operations which are amenable to the use of robotic devices with a consequent increase in safety by reduction of radiological impacts, efficiency and economy.

Review of existing strategies in the Robotics industry and projected developments were performed to identify the available techniques for the various applications and highlight those features which are common to more than one application. Software needs and hardware requirements for each application were identified and estimated robot costs provided.

Studies which had already been made were identified and reviewed (e.g., the University of Florida study on assessment of maintenance problems in nuclear reactors, and the Oak Ridge National Laboratory work on the cleanup applications at the Three Mile Island power plant).

This information provided valuable input into the development of new robot logics and led to the award of the Phase II contract for the development of a usable robot.

Contract Period: September 1, 1983 - March 31, 1984

PHASE 2: DEMONSTRATION OF POTENTIAL ROBOTIC APPLICATIONS IN THE MANAGEMENT OF HAZARDOUS WASTES AT THE WEST VALLEY DEMONSTRATION PROJECT

Client:
U.S. Department of Energy
West Valley Demonstration Project Office
P.O. Box 191
West Valley, NY 14171

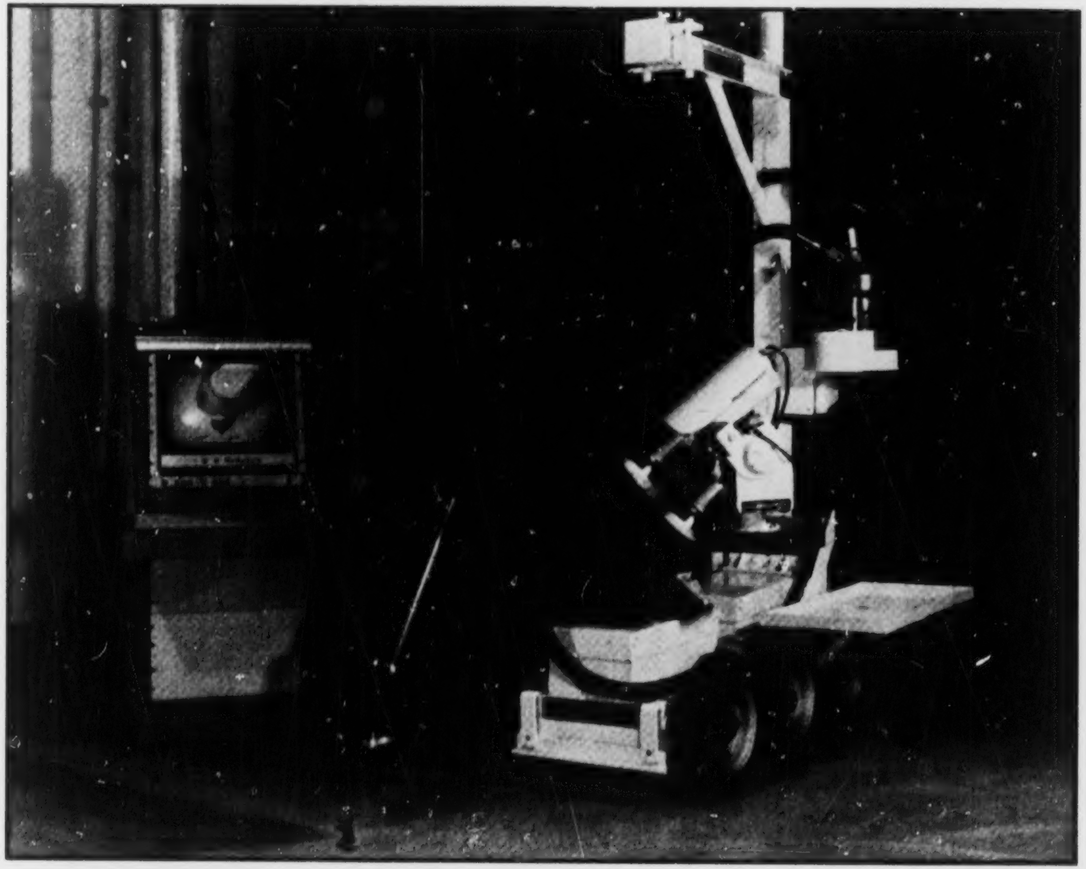
Project Officer: Robert E. Stiens Telephone: (716) 942-3235

Abstract: A robot is being developed to be deployed to decontaminate highly radioactive cells. It will be wheel-driven and will have the following capabilities:-

1. Vision.
2. Vacuuming capability. Top priority is cleaning at the ground level and then moving upward as high as capable with the machine.
3. Directional lifting capability of between 35 to 50 lbs.
4. It will pick up objects and load into a drum (30 gal. capacity). The drum will be moving with the robot on a wheel-driven cart or will be on coasters.
5. Flexibility is built into the arm for attachment of a tool kit as and when required.
6. The tether and tires of the wheels are capable of decontamination by spray cleaning or wiping, etc.
7. The machine and the collecting drum are able to clear at least 3 to 4 inch obstacles.
8. Sand blasting and hose blasting the walls.
9. Pipe cutting.

The robot is operable from a console located at least 150 feet away and takes advantage of the viewing windows already existing in the facility.

Contract Period: March 12, 1984 - March 1985



VEC'S "ROD" ROBOT

ROD's wide range of capabilities are being employed at the West Valley Demonstration Project, West Valley, New York

VEC'S "ROD" ROBOT
A REMOTELY OPERATED AND DRIVEN ROBOT

The ROD Robot consists of a standard 6 axes American Robot Corporation high-precision robot mounted on a highly maneuverable rough-terrain vehicle, and a tether management system which keeps the control cable off of a contaminated floor out to a maximum range of 200 feet. The television camera and lights mounted on the vehicle permit control of both the robot and the vehicle from the remote operator console.

The ROD Robot is immediately ready to go to work. After the fixed end of the tether is fastened on a wall, the door of the contaminated area is opened and the robot runs in to do its work.

With the standard gripper on the robot's arm, it can pick up objects from the floor and deposit them into a container on the vehicle, grasp a vacuum cleaner nozzle for cleaning floors and walls, or hold small tools.

The ROD Robot solves for the first time the problems of mating a versatile robot to a maneuverable vehicle and the management of the electrical cables for power and control.

The ROD Robot is well-suited for a large range of applications.

- Handling of radioactive and toxic wastes in buildings and outdoors.
- Monitoring of radiation levels.
- Decontaminating radioactive work cells.
- Performing visual surveys.
- Dismantling radioactive work cells.
- Handling of explosive materials.
- Performing work in health hazardous environments -- noise, vibration, odors, smoke, excessive heat or cold, oil spray, flying chips, monotony, and risks that could result in serious personal injury.

Specifications:

- Remote operation up to 200 feet using camera and monitor
- Lifting capability of 20 to 50 pounds, depending on model
- Working envelope of robot arm 40 or 60 inches, depending on model
- Vacuuming capability
- Flexibility in the arm for easy attachment of various tool kits such as for sand-blasting and pipe-cutting
- Vehicle able to clear 3 to 4 inch obstacles
- Drawbar pull on dry pavement is 1300 pounds
- Tether and vehicle tires capable of decontamination by spray cleaning or wiping
- Robot controlled by manual joystick, or pre-programming
- High precision and repeatability
- Powerful robot controller — 32 bit architecture, Motorola 68000-based, UNIX operating system
- Easy to program

TO INQUIRE, PLEASE WRITE TO THE ADDRESS BELOW OR CALL (412) 363-7777

VIKING
ENERGY
CORPORATION

121 N. Highland Ave., Suite 203
Pittsburgh, PA 15206

Mr. **Mavroules**. Thank you. Our next witness is Dr. Peter Andrulis. For a moment, I thought there was another Greek in this room. I understand your name is Lithuanian, am I correct?

Mr. **Andrulis**. That is correct.

Mr. **Mavroules**. Please continue, Doctor.

TESTIMONY OF DR. PETER J. ANDRULIS, ANDRULIS RESEARCH CORP., BETHESDA, MD

Mr. **Andrulis**. I want to thank you, Mr. Chairman, and members of this subcommittee for providing me the opportunity to appear before you today.

We felt privileged in 1982 to be able to contribute to the passage of the Small Business Innovation Development Act, and currently, Dr. Marilyn Andrulis, our president and CEO, has accepted the responsibility for cochairing Milt Stewart's National Innovation Network Initiatives for the SBID in the State of Maryland.

I would like to address four topics today. First, I would like to, for perspective's sake, tell you a little bit about Andrulis Research Corp. Second, I would like to describe what it was like trying to fund commercializable R&D before the SBID Program. Third, I will present the current status of Andrulis' product R&D that has resulted from the SBID Program, and fourth, I will address our future R&D directions, their reliance on the SBID Program and anticipated national benefits.

Andrulis Research was founded for the purpose of supporting Federal R&D in such areas as defense and health programs. Today, we are a highly diversified company, in R&D, manufacturing and technical services providing jobs for over 70 people in Maryland, Virginia, the District of Columbia, and the State of Utah.

For perspective on non-SBID R&D that has been performed at Andrulis, some examples include the development and at-sea submarine testing of state-of-the art improvements in submarine localization and tracking and in weapons aiming and accuracy; development of real-time performance assessment systems for air combat training of Navy fighter pilots; development of improved anticancer drugs; development of local area network computer technology for acquisition and management of worldwide cancer research and cancer treatment data; and finally, development and validation of survey tools to assess child mental health protection in pediatric hospitals.

It has been said many times that entrepreneurs are highly creative and energetic. I leave it to others to determine whether these traits precede the entrepreneurial process and cause it or are simply survival skills acquired from endless searches for capital. Whichever, before SBID, the words research funding would have been a contradiction in terms at Andrulis were it not for the use of a large number of business strategies. We aggressively pursued R&D funding in any Federal program and agency where we could apply the creativity of our staff. We established IR&D budget line items as high as Federal auditors would allow. We initiated a series of incentives to elicit more sweat from sweat equity, and we even established a separate nonprofit institute which acquired three substantial research grants in cancer treatment and drug addiction chemistry and in the detection of unreported crime. When the SBA admitted Andrulis to its 8(a) program, this permitted us to provide research sponsors with the additional option of rapid project start up as well.

In May 1982, we were invited by Congressman Mitchell to testify before the House Committee on Small Business in support of the passage of SBIDA. We unequivocally endorsed the solutions presented in SBIDA, the set aside of a small portion of Federal research budgets to fund small business private development. We presented evidence at that time that it was easier for us to secure research funding half the world away in Europe than it was down the street from us in Bethesda.

Now, only 3 years later, it gives us great pleasure to be able to share with you that the SBID Program has permitted Andrulis under DOD sponsorship to develop unique polymers for special purpose defense applications, and under sponsorship from the National Cancer Institute, to design and test new, extremely promising anticancer drugs with exciting commercial prospects.

In 1981, Andrulis was proud to have been selected as an SBIR awardee from the prototype program Roland Tibbetts conceived and established at the NSF. Including that award, Andrulis has had a 60-percent success ratio, receiving 6 SBID phase I and II grants and contracts from 10 proposals submitted to NSF, NIH, and DOD.

With an SBID award from DOD, Andrulis scientists have designed and developed ultra high purity polymers with unprecedented resistance to heat, oxidation, and brittleness. With continued SBID funding, they are now fully exploring these polymers' characteristics and studying production to address certain critical defense needs. When in production, Andrulis will be providing these polymers to DOD agencies and to a number of prime contractors for critical applications.

With an SBIR award from the National Cancer Institute, Andrulis scientists have designed and developed several stable versions of the most active, least toxic metal anticancer drug known. Early preclinical evaluations of these drugs against a form of cancer unfriendly to this particular class showed, in one typical case, that treated animals lived on average 340 percent as long as those that were untreated, and that 18 of 24 treated animals were cured.

The original drug in this class, cisplatin, is the largest selling anticancer drug in the world, with 1984 sales estimated at $150 million and with some future sales estimates ranging up to as high as $1 billion per year. Andrulis' analogs of this drug developed with the SBID funding possess the same physical characteristics that yielded less patient toxicity, greater tumor toxicity and effectiveness against a greater variety of tumors that was possessed by a very active, but unstable successor to cisplatin.

For all these reasons, commercialization prospects of these drugs appears to be promising. Pharmaceutical industry interest has been intense to say the least, predating even completion of phase I studies.

In phase II, one of only three phase II's funded by the National Cancer Institute, we received the highest study section score of any phase I or phase II proposal submitted to the entire National

Cancer Institute. In work just commenced, Andrulis is fully developing these drugs, characterizing their toxicity, and looking at pharmaceutical firms which, with costs of R&D escalating, with too many mature products and markets, are increasingly looking outside for new products. With cancer chemotherapy now a proven treatment alternative, and, therefore, an open ended, rapidly expanding market, it remains for Andrulis only to consider their proposals and negotiate the best possible business arrangement.

In addition to current phase I and phase II SBID efforts, Andrulis has eight outstanding proposals in such diverse technical areas as integration of incompatible Defense Department data bases, Defense resources allocation modelling, guided delivery of anticancer drugs to specific tumors and specific sites, and chemical warfare agent neutralization.

Since all of these proposals possess supporting data, unique personnel expertise, or both, prospects for funding appear promising.

If we are successful in securing continued SBID funding, products from these programs will substantially improve the speed of defense information flow and therefore defense decisionmaking, create new medical information management processes and finally, treat heretofore totally untreatable forms of cancer.

In the current business climate, with the rapidly fluctuating interest of various sources of risk capital, and the constant onerous burdens in acquiring it, it is safe to say that without SBID, we could test few of these hypotheses with our limited resources and develop none of them to a commercially viable state.

In conclusion, I have several recommendations, but in the interest of time, I will skip over all, but what I feel is the most important one.

The SBID Program needs time to work. The very idea of entrepreneurs wending their way through Federal bureaucracies and processes to secure phase I funding and of Federal program officials using a totally new vehicle to reach previously unknown individuals who are unfamiliar with their policies and procedures, all for the purpose of product development is so totally alien in all its parts as to be a wonder that it works at all.

I believe very strongly as people on both sides learn, as processes get debugged, as skeptics get neutralized, as legitimate concerns get put to rest, and as results appear, results with unequivocal impact on the marketplace or on national needs, then we will all of us benefit from what Senator Rudman, my good friends, Congressman LaFalce, and Roland Tibbetts, and so many others who labored for the passage of SBIDA, have sought: A national industrial policy that truly works.

Mr. MAVROULES. Very good. Thank you very much for your testimony.

[Mr. Andrulis' prepared statement follows:]

PREPARED STATEMENT OF DR. PETER J. ANDRULIS, ANDRULIS RESEARCH CORPORATION, BETHESDA, MD

I want to thank the Chairman and members of this Subcommittee for providing me the opportunity to appear before you today. I want to express my appreciation for the Small Business Innovation Development Act. It has had a substantial impact on our ability to address some of the nation's most important defense and health topics, to create new jobs, and to generate new taxable revenues in our nation's economy. We felt privileged in 1982 to be able to contribute to the passage Act and currently, Dr. Marilyn Andrulis, the President and Chief Executive Officer of ANDRULIS Research Corporation, has accepted the responsibility for Co-chairing the National Innovation Network initiatives in the State of Maryland.

I'd like to address four topics today. First, I want to tell you a little about ANDRULIS Research Corporation. Second, I'd like to describe what it was like trying to fund commercializable R&D before the SBIR Program. Third, I will present the current status of ANDRULIS' product R&D due to SBIDA. Finally, I will address the future R&D directions, their reliance on the SBIR Program and anticipated national benefits.

ANDRULIS Research Corporation was founded as an R&D firm for the purpose of supporting Federal R&D, especially Federal defense and health programs. Today, we are a highly diversified R&D, manufacturing and technical services firm providing jobs for about 70 highly motivated, creative people at sites in Maryland, Virginia, The District of Columbia and Utah.

Some of the more exciting examples of ANDRULIS R&D efforts include:

- Development and at-sea submarine testing of a proprietary state-of-the-art improvement in submarine location and tracking and weapons aiming and accuracy.
- Development of Navy fighter pilot real-time performance assessment system for air combat training.
- Design and development of improved metal anticancer drugs.
- Development of Gypsy Moth attractant.
- Development of Local Area Network computer technology for acquisition and management of world wide cancer research and cancer treatment data.

- Development and validation of survey tools to assess child mental health protection in pediatric hospitals.

In addition, ANDRULIS supports the nation's defense, health and other interests with technical efforts such as:

- Electronic product assurance and effectiveness for the Navy.
- Military resources planning and distribution system development for the Defense Department.
- Production of metal anticancer drugs for clincial trials by the National Cancer Institute and by Memorial Sloan Kettering Cancer Center.
- First article production of a submarine Noise and Vibration Monitoring System for the US Navy.
- Development of female soldiers equipment and clothing standard and performance measures for the US Army.
- Planning support for all chemical and biological defense for the Army.

Research and Development at ANDRULIS before SBIR

It has been said many times that entrepenuers are highly creative and energetic. I leave it to others to determine whether these traits preceed the entrepenurial process or are simply survival skills acquired from endless searches for capital. Whichever, before SBIR, the term "research funding" would have been a contradiction in terms at ANDRULIS were it not for use of a large number of business strategies. We aggressively pursued R&D funding in any program, in every agency, where we could apply the creativity of our staff. We established IR&D budget line items as high as federal auditors would allow. We initiated a series of incentives to elicit more sweat in sweat equity and we established a separate non-profit institution which acquired three substantial research grants in cancer treatment, in drug addiction chemistry and in unreported crime detection. When the SBA admitted ANDRULIS to its 8(a) Program, this permitted us to provide research sponsers with the additional option of rapid project start up as well.

In May 1982, we were invited to testify before the House Committee on Small Business in support of the passage of SBIDA. At that time, we identified four factors which, collectively, virtually prohibited small businesses from securing funding from the National Institutes of Health. We identified these factors as a bias toward awarding research contracts to hospitals, non-profits and universities; the de facto set-aside of virtually 100% of research grant funding for these same institutions by the peer review process; the Catch-22 prohibitions relating to unsolicited proposals; and institutional protection of intramural researcher resistance to small business as a qualified source. We unequivocally endorsed the solution presented in SBIDA, the set aside of a small portion of Federal research budgets to fund small businesses. We presented evidence at the time that it was easier for us to secure research funding half a world away in Europe than it was up the street from us in Bethesda.

Now, only three years later, it is our greatest pleasure to be able to share with you that the SBIR program has permitted ANDRULIS, under sponsorship from DoD, to develop unique polymers for special purpose defense applications, and under sponsorship from the National Cancer Institute, to design and test platinum anti-cancer drugs with exciting commercial prospects.

The SBIR Era at ANDRULIS

In FY 81, ANDRULIS was proud to have been selected as an SBIR awardee from the prototype program Roland Tibbetts conceived and established at the National Science Foundation. Including that award, ANDRULIS has had a 60% success ratio, receiving six SBIR Phase I and II grants and contracts from 10 proposals submitted to NSF, DoD, and NIH.

I think a few words about several of the projects will clearly illustrate that, at least in our case, the SBIR program is doing exactly what it was designed to do: create Federal incentive to business, resulting in commercial product development, prospective tax revenue base enhancement and increased employment and yielding corollary prospective benefits in such areas of national interest as defense and health care.

With an SBIR award from the Defense Department, ANDRULIS scientists have designed and developed ultra-high purity polymers with unprecedented resistance to heat, to oxidation, and to brittleness. With continued SBIR funding, they are now fully exploring these polymer characteristics and studying the production of quantities sufficient to address certain critical defense needs. When in production, ANDRULIS will be providing this polymer to DoD agencies and to numbers of DoD prime contractors for critical applications.

With an SBIR award from the National Cancer Institute, ANDRULIS scientists have designed and developed several stable versions of the most active, least toxic metal anticancer drug known. Early preclinical evaluations of one of these drugs against a form of cancer unfriendly to this class showed treated animals lived on average 340% as long as those untreated. Furthermore, 18 of 24 were considered cured. The original drug in this class, cisplatin, is the largest selling anticancer drug in the world, with 1984 sales estimated at $150M with some future sales estimates ranging up to $1 billion per year. ANDRULIS drugs developed with SBIR funding possess the same physical characteristics which yielded less patient toxicity, greater tumor toxicity and effectiveness against a greater variety of tumors of the very active but unstable cisplatin successor. For all these reasons, commercialization prospects of these drugs appear to exist. Pharmaceutical industry interest has been intense, predating completion of Phase I studies.

ANDRULIS' Phase II proposal, one of only three that were funded by the National Cancer Institute, received the highest Study Section (Peer Review) score of any Phase I or Phase II proposal submitted to NCI. In work just commenced, ANDRULIS scientists are fully characterizing the toxicity, tumor efficacy and other factors of this new metal drug family. Phase II results will be used to apply to the FDA for permission to begin clinical trials. At that time, capital requirements, from whatever source, will be enormous. Fortunately, pharmaceutical firms, with the cost of their R&D escalating and with too many mature products, are increasingly looking outside their walls for proven ideas and semi-finished products. With cancer chemotherapy a proven treatment alternative and therefore an open-ended, rapidly expanding market, it remains for ANDRULIS to consider all their proposals and negotiate the best business arrangement.

Future R&D, The Need for the SBIR Program and Future Products

In addition to current Phase I and Phase II SBIR R&D efforts, ANDRULIS has eight outstanding proposals in such diverse technical areas as integration of certain incompatible Defense Department data bases, Defense resources allocation modelling, guided delivery of anticancer drugs to specific tumors or sites, and stabilization of a clinically proven anticancer agent. Since all of these proposals possess supporting data, unique personnel expertise, or both, prospects for funding appear not unreasonable.

If we are successful in securing continued SBIR funding, products from these programs will substantially improve the speed of defense information flow and decision making, create new medical information management processes and treat heretofore totally untreatable forms of cancer.

In the current business climate, with the rapidly fluctuating interest of sources of risk capital and constant onerous burdens in acquiring it, it is safe to say that without SBIR we could test few of these hypotheses with our limited resources and develop none to a commercially viable state. Thus, without SBIR none of these products would see the light of day.

Recommendations

In order to improve the functioning of the SBIR Program, the following recommendations are proposed:

1. Eliminate, where applicable, funding gaps between Phase I and Phase II.
2. Permit those who wish to bypass Phase I proposal submissions to apply directly for Phase II at their own risk.
3. For the SBIR Program at DHHS, establish evaluation criteria by NIH Study sections that are consistent with the feasibility objectives of Phase I SBIR and monitor its utilization instead of permitting use of the far more rigorous PHS grant criteria currently being used.

4. The SBIR Program needs time to work. The very idea of entrepenuers wending their way through Federal bureaucracies and processes to secure Phase I funding and of Federal program officials using a totally new vehicle to reach previously unknown individuals unfamiliar with their policies and procedures all for the purpose of product development is so totally alien in all its parts as to be a wonder that it is working at all. As people on both sides learn, as processes get debugged, as skeptics get neutralized, as legitimate concerns get put to rest and as results appear, results with unequivocal impact in the marketplace or on national needs, then we will all of us benefit from what Roland Tibbetts, Senator Rudman, Congressman LaFalce and countless others who labored for the passage of SBIDA have sought.

Thank you.

Mr. MAVROULES. I want to go back to a statement you made. I am on the Armed Services Committee, and you referred to some of the work you are doing on submarines. Is that in the sonic area?

Mr. ANDRULIS. Sonar.

Mr. MAVROULES. Thank you for correcting me. I have just one general question I am going to ask, and I would ask each of you to respond to me.

One question I have, and you referred to it somewhat, Dr. Andrulis, is at what stage of development would each of you be today without the SBID Program relative to your own businesses and companies? Would you care to try that one?

Mr. JOSHI. We at UES have had this program for about 2½ years starting with phase I, and I would say in about a year to two years, we will have some process or product out on the marketplace.

We have about three ideas which look very promising, and we are very excited about them.

Mr. MAVROULES. Let me rephrase it. Where would your company be today without the SBID Program?

Mr. JOSHI. If we didn't have the SBID Program, we would now be testing some of the ideas we have, but the laboratories would not have progressed as much. We would not have as good a name as we have in DOD, NSF, DOE and other agencies.

Mr. MAVROULES. Dr. Pronko, do you want to answer?

Mr. PRONKO. Historically, we went into developing our materials research facility prior to a full awareness of the SBID Program. So we assumed the inherent risk in committing ourselves, and the responsibility of research programs. In retrospect, I realize that without the SBID Program, we probably would not have—I am certain we would not have our materials research facility anywhere near the level of functionality that it is at now.

In fact, there could have been some risk of its complete collapse at some point, just because of the timing to get substantial programs off the ground and get through the process of submitting proposals to unknown people in unknown agencies.

So in my opinion, it has been very much responsible for our survival.

Mr. MAVROULES. Dr. Saluja?

Mr. SALUJA. Without the SBID Program, we would not have developed a mobile robot system like we have. We had submitted this proposal a couple of years earlier to U.S. Department of Energy, and it was not funded.

We had after that forgotten about this process and gone our way in other areas of development. Then the SBID Program came back, or this opportunity came back. We resubmitted that proposal, and this time it was funded with the result that now we have a viable machine which nobody else has.

I have gone around the country and talked to a lot of utilities, nuclear facilities. They claim there is a need. They have not developed some of the requirements for the need, as yet, but I am sure that there is a need, and we will be able to commercialize it as we develop the units through that phase.

Mr. **Mavroules**. Thank you very much. Dr. Andrulis, you referred somewhat to this when you were giving your testimony. Do you want to expand upon that at all?

Mr. **Andrulis**. Just briefly, sir. I think Harold Lonsdale had a series of terms that he used to apply to the SBID Program, such as a brokering function. One that he did not mention that I heard applied to the program is that it performs a sort of pre-venture capital, a precapitalization function.

One of the vicious circles that has existed for many small businesses or entrepreneurs with creative ideas is frankly that if you can't get funding from the Federal Government for raw ideas that blend with particular program needs, you are not going to be able to get into the commercial marketplace until it has been proven in principle, a catch-22 which is very difficult to escape.

The SBID phase I funding in particular provides the opportunity to break that vicious circle. Without it, there is no way we could have funded or developed the products and processes that we have been developing today.

Mr. **Mavroules**. Gentlemen, thank you very much for excellent testimony. If you feel that perhaps you have more to add to this hearing, we would appreciate very much that you refer to it in writing in care of the Small Business Oversight Subcommittee office. Thank you very much.

Now we have our final witness for this morning's hearing, Richard Shane, Office of Innovation, Research & Technology, U.S. Small Business Administration. Mr. Shane?

TESTIMONY OF RICHARD J. SHANE, ASSISTANT ADMINISTRATOR, OFFICE OF INNOVATION, RESEARCH & TECHNOLOGY, SMALL BUSINESS ADMINISTRATION

Mr. **Shane**. Thank you, Mr. Chairman. Before I begin, I would like to introduce Mr. George Morning of my staff who will be helping with any questions you may have.

Mr. **Mavroules**. And let me also thank you for sitting through most of the testimony here this morning. We observed that quite optimistically.

Mr. **Shane**. I would like to be given the opportunity to address quite a number of Mr. Cooper's comments which I think I can straighten out for the record.

Mr. **Mavroules**. Whatever you wish. Please go ahead.

Mr. **Shane**. In the interest of time, I will cut my statement down, because it is going into the record anyway.

Mr. Chairman, I appreciate the opportunity to appear before you today to express the Small Business Administration's thoughts concerning the first 2 year's results of the Small Business Innovation Development Act of 1982.

I would like to begin by commending the House Small Business Committee for your support in steering the authorizing legislation through the House and for your continuing interest and support of the Small Business Innovation Development Act.

We feel that the act is a splendid example of a bipartisan program to stimulate technology advancement through small and minority and disadvantaged concerns and to increase private sector commercialization of innovations derived from Federal research and development. The end result of such actions being job creation, tax revenue and the growth of U.S. technology.

At the outset, I would like to state for the record that all things considered, that the administrator of the SBA and I are very pleased with the implementation, administration and the results of the program. The last two years have not been without problems, but they have been addressed and resolved to the benefit of the program and small business. The 12 participating agencies have for the most part approached the new program with a spirit of cooperation and support. Experience gained to date strongly suggests and fortifies our firm belief that the program will prove to be highly successful and exceed all expectations.

The second year of the Small Business Innovation Development Act can best be described as one of expansion and maturity. In the first year, the basic program elements were implemented. These included the program policy directive, the pre-solicitation announcement, the mailing list, the solicitation process, outreach techniques and materials, the award of phase I funding agreements and the annual report.

In the second year, the program expenditures more than doubled. Phase II awards were made for the first time. The mailing list was computerized and contains upwards of 35,000 names and addresses. The conferences and seminars matured from fundamentals to specific topic discussions. Agency SBID Program procedures were refined and the SBA Commercialization Matching System to link venture capital dollars to SBID awardees was completed.

It is the SBA's view that all the major program milestones for the second year have been accomplished and accomplished well.

In the area of outreach, we are continuing in our efforts, because of the profound change in the Federal agencies and the SBID arena for research and development acquisition. To meet this need, we settled on several parallel courses of action which included participation in conferences and seminars, developing and coordinating news releases, television and radio interviews, development and dissemination of program pamphlets, contact and interaction with small business associations and minority and disadvantaged outreach programs.

We have just completed our annual report which I fully planned on handing you, but we are still awaiting the printed copies from the Government Printing Office.

We feel the report is an accurate and fair representation of the activities of the second year of the program, and the report goes into specific details in the areas of implementation actions, acquisition data, and technical aspects of the program.

Some of the highlights which will be called out in the report are that expenditures grew from approximately $44 million a year to $112 million during fiscal year 1984, and proposals received decreased slightly from 8,814 and 7,955, but we feel quite strongly that the quality of proposals increased dramatically.

Awards made went from approximately 760 in fiscal year 1983 to 1337 in fiscal year 1984 which figure includes phase I's and phase II's. Solitication topics increased dramatically in 1984. State awards spread across 46 States, in lieu of the 40 States previously awarded in fiscal year 1983.

At this point, Mr. Chairman, I would like to close by restating our pleasure with the results of the second year of the program, and we feel it has been a highly successful year.

This concludes my prepared statement. I shall be happy to answer any questions the subcommittee may have.

[Mr. Shane's prepared statement follows:]

Prepared Statement of Richard J. Shane, Assistant Administrator, Office of Innovation, Research & Technology, Small Business Administration

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

I appreciate this opportunity to appear before you today to express the Small Business Administration's thoughts concerning the first two year's results of the Small Business Innovation Development Act of 1982.

I would like to begin by commending the House Small Business Committee for their support in steering the authorizing legislation through the House and for your continuing interest and support in the Small Business Innovation Development Act.

The Act is a splendid example of a bipartisan program to stimulate technological advancement through small and minority and disadvantaged concerns and to increase private sector commercialization of innovations derived from Federal research and development. The end results of such actions being job creation, tax revenue and the growth of U.S. technology.

At the outset I would like to state for the record that, all things considered, the SBA is very pleased with the implementation, administration and results of the program. The last two years have not been without problems, but they have been addressed and resolved to the benefit of the program and small business. The twelve participating agencies have for the most part approached the new program with a spirit of cooperation and support. Experience gained to date strongly suggests and fortifies our firm belief that the program will prove to be highly successful and exceed all original expectations.

I would like to briefly present an overview of SBA's philosophy and approach to the Small Business Innovation Development Act. Detail program information and statistical data for fiscal years 83 and 84 are presented in SBA's annual report to the Congress.

The Two Primary Programs

The law set into being two separate and distinct programs to be implemented during fiscal year 1983. The primary program is the Small Business Innovation Research (SBIR) program and the secondary program is the Research and Research and Development Acquisition Goaling Program.

Under the SBIR program each agency with an extramural budget for research or research and development in excess of $100 million for fiscal year 1982, or any fiscal year thereafter, shall establish an SBIR program. Program funding is from the participating agency's current extramural funds and will reach a maximum of 1.25% for civilian agencies within four years and for the Department of Defense within five years. It is estimated that the 1.25% will translate to $500 million dollars in fiscal year 1987.

The participating SBIR agencies are: Department of Agriculture, Department of Commerce, Department of Defense, Department of Education, Department of Energy, Department of Health and Human Services, Department of Interior, Department of Transportation, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation and the Nuclear Regulatory Commission.

The law directed that the program be a competitive three phase program process. In Phase I the majority of awards will be $50,000 and will determine as far as possible the scientific and technical merit and feasibility of ideas. Under Phase II the results of Phase I projects are evaluated and those with the most potential will be funded to further develop the proposed idea for an additional one or two years. The majority of Phase II awards will be funded for approximately $500,000.

Phase III is the keystone of the program and brings into play private sector investment and support to bring the innovation into the marketplace. No further SBIR funds will be involved. But if the Federal agency has continued interest in the innovation, funding agreements may proceed under normal acquisition programs.

The Research and Research and Development (R&R&D) Goaling Program requires agencies with an R&R&D budget in excess of $20 million for any fiscal year to establish small business goals for R&R&D funding agreements. The goal to be set annually cannot be less than an agency's achievement during the previous fiscal year. In addition to the previously stated 12 SBIR agencies seven additional agencies are included: Department of Justice, Department of Housing and Urban Development, Agency for International Development, Smithsonian Institute, Tennessee Valley Authority and the Veterans Administration.

Implementation Actions

The second year of the Small Business Innovation Development Act can be best described as one of expansion and maturity. In the first year, the basic program elements were implemented. These included the program Policy Directive, the pre-solicitation announcement, the mailing list, the solicitation process, outreach techniques and materials, the award of Phase I funding agreements and the annual report. In the second year of the program, expenditures more than doubled, Phase II awards were made, the mailing list was computerized and contains upwards of 35,000 names and addresses, the conferences and seminars matured from fundamentals to specific topic discussions, agency SBIR program procedures were refined and the SBA Commercialization Matching System to link venture capital dollars to SBIR awardees was completed. It is the SBA's view that all the major program milestones for the second year have been accomplished.

Public Information and Outreach

The SBA recognized from the outset that a major effort had to be made in public information and outreach. The legislation was a profound change in the Federal agencies and the small business arena for research and development. To meet this need we settled on several parallel courses of action which included participation in conferences and seminars, developing and coordinating news releases, television and radio interviews, development and dissemination of a program pamphlet, contact and interaction with small business associations and minority and disadvantaged outreach programs.

SBA's Annual Report to Congress

We have completed our second annual report to the Congress. We feel the report is an accurate and fair representation of the activities of the second year of the program. The annual report goes into specific details in the area of implementation actions, acquisition data and technical aspects of the program.

Some Highlights of Interest are:

	FY 83	FY 84
o Expended in SBIR Awards	$44 million	$112 million
o Phase I Proposals received	8814	7955
o Awards made:		
Phase I	760	999
Phase II	0	338
o Solicitation Topics	614	1650
o State awards	40	46

Mr. Chairman, I would like to close by restating our pleasure with the results of the second year of the program.

Mr. Chairman, this concludes my prepared statement. I shall be happy to answer any questions the Subcommittee may have.

Mr. **Mavroules**. I have one question, and then if you like you could respond to the question put forth by Mr. Cooper. Let me ask my question first.

I have heard that the SBA is developing a system to link SBID participants with potential sources of capital.

Mr. **Shane**. That is correct.

Mr. **Mavroules**. These sources include venture capital companies, large corporations, and State governments, is that correct?

Mr. **Shane**. We now have in place a computerized matching system which has programmed into it the major venture capital sources in the country. We are also sending letters to large corporations who may have interest in venture capital investment and wish to be placed in the computer.

In the other part of the program, we have put in all the award winners within the SBID program. Letters have gone out to them this week asking for their permission to begin matching potential sources of venture capital with SBIR awardee winners and to try to bring together a marriage of the two.

It is the only system of its kind in the country that we are aware of, and we feel it is going to be a major breakthrough for the program in the area of phase III where it is so important to acquire venture capital.

Mr. **Mavroules**. Very good. Thank you very much, and now if you would respond to Mr. Cooper's inquiry.

Mr. **Shane**. Yes, I would like to. If I understood Mr. Cooper's question, what he was pursuing what does the Government receive under the SBID Program and should there be a user fee?

I think several extremely important points were missed. No. 1, highly qualified small businesses are responding to Government-solicited technical topics.

So small businesses are solving Federal Government technical problems. The implication of the question as I understand it is that the program is providing money, and small businesses are allowed to study anything they choose. The program is solving major Government technical problems.

Number two, the Federal Government takes a royalty-fee license in all discovered technical data and patents that are made which will in turn save the Government a considerable amount of money as these products come to fruition in the commercial market.

Last, if the Federal agency had a continuing interest in this particular development, they can contract for it under standard contracting procedures. The Government is receiving a many-fold payoff under this program.

I cannot understand the analogy to the School Loan Program, because we are doing this in response to the high technology acquisition needs of the Federal Government.

Mr. **Mavroules**. How do you feel about some kind of a payback system, as my colleague suggested?

Mr. **Shane**. I think the Government is receiving its payback right now in the fact that they are receiving needed technical knowledge and solutions to problems. These are not unsolicited proposals. These are direct responses to Government technical problems, and the payoff is the Government gets a resolution to the high technology problem.

No. 2, as it goes down the line and it hits the commercial marketplace, the Government can buy it without paying a royalty. The Government owns a royalty free license.

Under the patent funding agreement, if the company fails to patent within 2 years, then the Government has the ability and authority to proceed with the technical knowledge.

Mr. **Mavroules**. I have no further questions, Mr. Shane, unless you want to continue your testimony. I am very interested in your response to the question put forth by Mr. Cooper.

Do you have anything else to add?

Mr. **Shane**. Those are my comments.

Mr. **Mavroules**. I want to thank you, and I want to thank all of the participants this morning. It has been a great, great hearing. Thank you very much. I declare the hearing closed.

[Whereupon, at 12:40 p.m., the subcommittee adjourned, to reconvene subject to call of the Chair.]

APPENDIX

Appendix A.—Responses to Follow-up Questions: (1) James C. Sanders, Administrator, Small Business Administration, and (2) Dr. Krishan K. Joshi and Dr. Peter P. Pronko of Universal Energy Systems, Dayton, OH

U.S. SMALL BUSINESS ADMINISTRATION
WASHINGTON, D.C. 20416

OFFICE OF THE ADMINISTRATOR

Honorable Nicholas Mavroules
Chairman
Subcommittee on General Oversight
and the Economy
Committee on Small Business
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

The Small Business Administration, Office of Innovation, Research and Technology is pleased to respond herein to the questions posed by you in your letter of April 26, 1985. We hope that the information provided will satisfy the Subcommittee's requests.

Question: 1. It is our understanding that a number of individual states are initiating their own programs to help small R&D firms. For example, we're told that New York has set up a matching grant program for winners of SBID awards.

Could you give us an idea of which states have developed their own programs as offshoots of the SBID concept, and how these state programs operate?

Answer: Since the inception of the Small Business Innovation Development Act of 1982 many states have become interested and active with similar and supporting programs. We have provided informational materials and counseling to state governments which have requested assistance. Our most recent information indicates that there are thirty states with programs and three states with pending programs. The state programs all vary in structure and method of support and assistance. Due to the multiplicity of approaches we have not attempted to collect the operational and administrative elements of the various state programs. Generally, the programs include, but are not limited to, technical, management, loan, grant, university and consulting assistance in various forms.

The states with programs are California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington and Wisconsin. The three states with program decisions pending are Maine, New Hampshire and New Mexico.

Question: 2.	We understand as well that some offices have been contacted by representatives from the Government of Great Britain who are interested in developing a program similar to SBIR. Are you aware of any countries that have a similar program, or are interested in developing one? Have you been contacted by other countries?
Answer:	At the current time no other country has a program similar to the Small Business Innovation Research program. Countries that have indicated an interest in the SBIR program and have required briefings have been Argentina, Austria, Brazil, England, Germany, Holland, Ireland, Italy, Japan, Norway and Spain. The greatest single interest has been in the simplicity and directness of the program as outlined in the SBID Policy Directive. It is anticipated that similar SBIR type programs will be implemented by other countries in the near future.
Question: 3.	We've received a response from OMB Director Stockman on the controversy surrounding the 1% cap on R&D funds set aside for small businesses. Mr. Stockman now evidently agrees with us that the set-aside should be 1 1/4%, as provided in the enabling legislation, and we're glad that this change was made. Did your agency have anything to do with this shift in postion? Does the administration fully support SBID now? Will you support an extension of the program?

Answer:	The Small Business Administration became aware of the oversight in the "Source Budget of the United States Government FY 1986" in January of this year. The paragraph in question appeared in the proposed budgets of five SBIR participating agencies. On January 28, 1985, I wrote a letter to Mr. Stockman concerning the apparent oversight. Mr. Stockman personally called me and assured me that it would be corrected. There never has been any question as to the Administration's support and interest in the Small Business Innovation Development Act. The question of recommendation of program extension is one that must be carefully considered and addressed. The Act is scheduled for sunset on September 30, 1988. At this particular time there is not enough hard data to make a supportable analysis and recommendation. Phase II awards were made for the first time during the past few months. The results of these awards will not be available until late 1986 at the earliest. We are pleased to state that there is a considerable amount of soft data which suggests that the program will be highly successful, but because of the limitations of hard data we are unable to make any supportable recommendation at this time.
Question 4.	One of the witnesses on a panel before yours indicated his support for a user fee payback concept on SBIR awards. What are your thoughts on this? Do you have any idea how it would work? Could the SBA impose the fee, or would the awarding agency have to impose it?

Answer: The Small Business Administration does not support the concept of a user fee in the programs under the Small Business Innovation Development Act. A user fee is utilized in programs that allow individuals to receive specialized services from the Federal Government. A few examples of these many services are passports, visas, airline routes, boat inspections, airplane inspections, bonding guarantees, and Federal camp ground use. The programs under the SBID Act are competitive acquisition of research by the Federal agencies. During the first year of the program there were approximately 10,000 proposals and 680 awards. By definition the SBIR proposers are clearly not the recipients of specialized Federal services.

Thank you for your interest and support of the program. If any additional information should be desired, please feel free to call upon me.

Yours truly,

James C. Sanders

James C. Sanders
Administrator

Response to the questions posed by the
Subcommittee on General Oversight and The Economy
to Dr. Krishan K. Joshi & Dr. Peter P. Pronko of
Universal Energy Systems in Dayton, Ohio,
at the April 25th hearing on the SBID Act

The question was "What would be the stage of development of our company without the SBIR program?"

We feel that this is a particularly appropriate question for us. The SBIR program came at a time when it was desperately needed by our company.

Today we can be considered, by most standards, to be a successful company. Approximately 4 years ago, when we began to test the dangerous waters of high tech investment, the situation was very different. At that time the company had clientele in the research services business consisting of contract programs with the local Wright-Patterson Air Force Base. In order to grow and prosper beyond these boundaries, it was necessary to consider corporate investments in our own R&D facilities as well as expanded programs with industry and other Federally funded R&D agencies.

Our decision was to establish a state-of-the-art technical center in materials science. This decision was based on a perceived need for such a facility in the high-tech materials community and an existing strong expertise within our own company. The company made a total investment of approximately $2 Million in this R&D Materials Research Facility.

As we proceeded to execute our plans we found several serious problems existed in terms of sustaining such a facility and fostering its growth. These problems involved adequate cash flow, long lead times to establish contacts and adequate name recognition. Our early situation was extremely perilous and it began to appear as though UES would have to divest itself of these R&D investments.

The broadly based SBIR program was brought into its expanded form shortly after our facility was operational. It became immediately apparent to us that this program was ideally suited to our needs.

The impact of the SBIR program was, after an initial familiarization period, very significant.

- It had a major impact on sustaining the existence of our Materials Research Facility.
- It provided an opportunity to focus our research energies into areas of commercial and industrial value by providing a source of marketing information.

- As a result of the SBIR program, our Materials Research Division is currently doing approximately $1 Million in funded R&D programs and is at the point of commercialization of this work in several areas.

In short, the SBIR program has been responsible for the strength that our Materials Research Division now enjoys and it has enhanced our credibility in the R&D community. In addition, through the stability of our in-house R&D facility, other related business has been generated and is resulting in rapid growth for the company.

0015B

Comments on questions posed by the Honorable Jim Cooper
Tennessee Small Business Committee

We recognize that Mr. Cooper's questions were posed in order to probe the nature of the program and to respond to adversaries and critics of the SBID act. The opinions expressed below are meant to help in that endeavor.

Small companies are more in a position of being disadvantaged than discriminated against. There is a certain amount of uncertainty about the performance of small companies as compared to large companies. This is where "prestige certification" through the SBIR program is of value to the smaller company since larger companies can rely on their past history and established track record. Likewise, a small company can easily fall prey to predatory pricing. Larger companies have been known to "buy-in" in order to gain access to both state-of-the-art technology and intelligence data. This may not happen on a regular basis, however, when it does, it is usually fatal to the smaller company.

The concept of a pay back scheme to the government for support under the SBID act is not an appropriate one since the SBIR topic solicitations are targeted directly at the governments R&D needs. The government is not making a loan, it is purchasing a service. In this sense, the SBIR program bears no resemblence to the student loan program. It is, rather, a serious contribution to establishing a foundation for highly innovative businesses that find themselves at a disadvantage with respect to possible dominance by larger firms. Whether we like it or not, high risk R&D falls into the necessary domain of government business. A vast number of important high risk efforts with very significant consequences would simply never be attempted without government support and funding.

0015B

APPENDIX B.—PREPARED STATEMENT OF BIO-METRIC SYSTEMS, INC., EDEN PRAIRIE, MN

BSI

BIO-METRIC SYSTEMS, INCORPORATED
9932 West Seventy Fourth Street
Eden Prairie, Minnesota 55344
612-941-0080

22 April 1985

Honorable Nicholas Mavroules
Congress of the United States
House of Representatives
1204 Longworth House Office Building
Washington, D.C. 20515

Re: The Small Business Innovation Development Act - Testimony of a small business participating in the SBIR program.

Dear Representative Mavroules:

We appreciate your invitation for us to participate in a hearing on the subject of this letter. Although we must decline due to time and cash flow considerations, we wish to provide you with a written testimony for the record.

The SBIR program has made a major contribution to the progress of Bio-Metric Systems, Inc. (BSI) in applying new and developing biotechnology to national needs (both civilian and military). The implementation of this program by several of the Federal agencies has been less smooth than desired, but significant improvements have been made and others still being seriously considered (e.g., "down time" between Phase I and Phase II funding).

BSI responded to the initial Department of Defense DESAT program solicitation in 1981, which provided us with an opportunity to demonstrate the applicability of biotechnology to defense against chemical and biological agents. In the Phase II contract from the Army (Chemical Research and Development Command), we produced a clear laboratory demonstration of a test kit for the soldier's use to detect T-2 (the "Yellow Rain" toxin) in the field, using monoclonal antibodies and enzymes. In the Phase III contract, we are developing manufacturing procedures for this new type of test kit and producing pilot manufacture lots for military field testing.

With SBIR program funding from several Federal agencies (Army, Air Force, NASA, NSF, NIH and USDA), BSI has been developing new diagnostic and detection kit technology for military use in the field and deep base and for civilian use on the farm and food processing facilities (e.g., antibiotics in milk, mycotoxins in grain, plant viral diseases), doctor's office and emergency room (e.g., overdose drug screening, sexually-transmitted disease), and extended space flight (diagnosis of infectious diseases).

BSI continues to participate in the SBIR program, expanding now into biocompatibility technology for substitute anatomical parts (e.g., replacement blood vessels, heart valves, in vivo sensors). The technology which the SBIR program has enabled us to develop and to continue to develop, is expected to find widespread application in the "home test kit" market as well as the clinical laboratory and medical device markets. With more than 95% of our funding from project contracts, BSI has expanded from a staff of 3 founding scientists in 1979, to 26 at the end of 1984. Our first products are expected to reach the U.S. market next year and to expand into worldwide markets within 3 years. We are fully persuaded that the SBIR program from the SBID Act will prove quite cost-efficient in the creation of new jobs and the export of new high-technology products to foreign markets.

Sincerely,

Peter H. Duquette, Ph.D.
Principal Investigator

For BSI

Patrick E. Guire

Patrick Guire, Ph.D.
Vice President and
Director R & D

APPENDIX C.—PREPARED STATEMENT OF HARVEY BRANDWEIN, PH.D., DIRECTOR, SCIENTIFIC AFFAIRS, GENETIC DIAGNOSTICS CORPORATION, GREAT NECK, NY

Genetic Diagnostics Corporation GDC 160 Community Drive, Great Neck, New York 11021

Ms. Cathleen Garman
Staff Director
Sub-Committee on Oversight and the Economy
Small Business Committee
U.S. House of Representatives
Rayburn Office Building
Room B363
Washington, D.C. 20515

April 22, 1985

Dear Ms. Garman;

I was very sorry not to be able to attend this weeks hearing on S.B.I.R., but thought that I would write you a short note conveying our thoughts on this important program that might perhaps be read into the record as our statement.

Genetic Diagnostics Corporation was founded in 1981 to develop diagnostic products for the human and animal health areas. In this time we have utilized a number of resources in an effort to get our product ideas off the drawing board and into development.Initially, we relied entirely on private investment to fund our efforts, and last year we succesfully completed a public offering to further meet our growing capital needs. In 1982, we became aware of the S.B.I.R. program and considered that this would be a way to seek funding for projects that were peripheral to our ongoing efforts. We were particularly attracted to the idea that the federal agencies, in seeking to stimulate the growth of high-tech companies such as ours, would finance the early, high technical risk portions of such projects and that we could then use these funds and the credibility of a government award to develop the idea to the point of commercialization.

Our S.B.I.R. efforts have been very successful, and to date we have received 5 Phase I Awards, and one Phase II Award. Our work has been funded by the U.S. Dept of Agriculture and the National Institutes of Health. In particular, we feel that the N.I.H. awards have been most helpful in stimulating both the growth and recognition of our company. These NIH awards have been concerned with novel uses of existing technologies, and we feel it is much to the credit of the NIH and their review panels that they were able to see the importance and merits of such projects. As a result of these awards, we have received considerable attention from other, much larger companies in our business and now look forward to several new products that will be coming out in the near future as a result of these S.B.I.R. projects. In fact, we believe that the opportunity to develop a `next' generation of products via the S.B.I.R. program is one of the main attractions to the program for small companies such as ours.

The availability of S.B.I.R. funds has also given our group some flexibility in the types of things we can work on.In choosing possible projects, we have been able to

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integrate areas that we are interested in and have expertise in with those areas that we believe will ultimately benefit the common good. In this way, immediate, short term commercialization is not the only criteria that is applied in discussing new products as is often the case when only private or internal funding is available. Such freedom of choice is another major plus for the program and guarantees that new and fresh ideas will always be tried in our collective efforts to make human progress through technology.

In conclusion, we feel that the S.B.I.R. program is a very important instrument that allows small high-tech companies to generate new sources of funding, which in time, if properly applied, can lead to recognition by larger companies and many new products. Our experience with the program dictates that the federal agencies can select ideas with high probablility of success and help these ideas to come alive in the real world. Our hope is that the merits of this program will be recognized and rewarded in seeing that the program is assured a long and healthy lifetime.

Sincerely,

Harvey Brandwein, Ph.D.
Director of Scientific Affairs

APPENDIX D.—PREPARED STATEMENT OF TOM CALLAHAN, MANAGING DIRECTOR, UNIVERSITY RESEARCH ENGINEERS & ASSOCIATES, TOPSFIELD, MA

University Research Engineers & Associates

Tom Callahan
Managing Director
Prof. Ken Astill
Director

Prof. Fred Nelson
Director
Bob Rondeau
Director

HONORABLE NICHOLAS MAVROULES, MC
CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

20 APRIL 1985

Subject: Comments on the SBIR Program

Dear Congressman Mavroules

Before elaborating on the subject of this letter, I would like to summarize our interpretation of the goals of the SBIR program, our company's objectives, level of effort, and a general history of our participation in the program. We will then offer what we consider to be constructive comments and recommendations for your consideration.

The SBIR program, as we perceive the intent of Congress, is in the best spirit of the United States. The program provides a great opportunity to compete against ones peers and ultimately succeed if there is a willingness to work hard and a refusal to quit in the face of some disappointments.

A successful SBIR program is in the best interest of the country. The various federal agencies get an opportunity to first stimulate and then to tap the ingenuity of the small business community.

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There is also a high probability of saving a great deal of money in the process. The program also provides an opportunity to broaden the base of potential development and manufacturing resources that would be available in a time of crisis. In order for the agency to get the most out of the program they must put a fair amount of work into it; the same as any small business must do; i.e., "quid pro quo".

Our company has participated in the subject program since the early part of 1983. In that time we have submitted a total of five proposals that took a total of 1.25 man years of effort (approximately) to prepare. We have responded to the public solicitation by the National Science Foundation (1)*, the Dept. of Energy (1) and the Dept of Defense (3; i.e., Defense Advanced Research Projects Agency, the U.S. Navy, and the U.S. Marine Corps). We were awared one Phase I contract by the Marine Corps.

The feasibility study for the Marine Corps; a machine to automaticlly fill 600 sandbags per hour under combat conditions, has been completed and a report issued to the cognizant agencies. Subsequently, based on the content of the report, the Marine Corps has requested us to submit a Phase II proposal to design, build and demonstrate the device that is described in the Phase I Technical Report. We are in the process of complying with that request and expect to have the proposal completed in the next two weeks.

We have had many discussions on the SBIR program not only within our own company but also with other small companies that are participating. We would like to offer the following comments for your consideration.

We sincerely feel that the intent of Congress to capture the innovative technical capability of small companies could be both a realistic and a cost effective program if it were implemented properly. There is no question, in our opinion, that the Dept. of Defense has developed the best program to fulfill the intent of Congress. The attempts made by the other agencies to offer a SBIR program of their own are amatuerish by comparison.

As we see it, there are four important attributes of the DOD program:

1. The projects are well defined.
2. The projects require a broader range of technical expertise.
3. The information and data base that is made available to the bidder is absolutely remarkable for both its quantity and quality.
4. The courteous and supportive assistance that is offered to all the potential bidders through the Defense Technical Information Service is extemely valuable and definitely contributes to the quality of the proposals.

It appears to us, after being involved these past few years, that the DOD actively supports the SBIR program and is working very hard to make it a success. You get the feeling that your efforts are welcome. On the other hand, the other agencies, and in particular the Dept of Energy, make you feel unwelcome and appear to give the program lukewarm support at best. The DOE's information resource is so poor that it is misleading.

Most of the companies that are bidding realize that the chances of getting an award are slim at best. Most of us are willing to put in the extra time and money to try to make sure the proposal represents a "best effort". When that proposal is rejected, most of feel that we deserve the courtesy of an objective, candid and written debriefing. In all cases except one we received such a debriefing and that one exception was the DOE. Their policy is to offer a verbal debriefing only. After listening to the ludicrous technical rationale that was applied to our proposal, I think I can understand why they have adopted that policy. I was told in our debriefing that the DOE was looking for some "real neat-o ideas" and our concept did not fit. Since we do not know how to cope with that kind of technological yard stick, I'm sure you will understand why we have decided to abstain from any further SBIR activity with the DOE.

In our opinion, if the SBIR implementation proceedures of the DOD were adopted by all of the participating agencies the program could be measuredly improved.

I would like to think that these comments might be useful in strengthening the SBIR program.

Thank you for you time and consideration.

Sincerely yours

Tom Callahan

Tom Callahan
Managing Director

APPENDIX E.—PREPARED STATEMENT OF TRIANGLE RESEARCH AND DEVELOPMENT CORPORATION, RESEARCH TRIANGLE PARK, NC

TRIANGLE
RESEARCH AND
DEVELOPMENT
CORPORATION
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NORTH CAROLINA 27709
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May 3, 1985

Congressman Nicholas Mavroules, Chairman
Subcommittee on General Oversight and the Economy
Committee on Small Business
U.S. House of Representatives
B-363 Rayburn House Office Building
Washington, DC 20515

Dear Mr. Mavroules:

We attended your oversight subcommittee hearings last week and as requested, would like to enter additional information into the record. As the recipient of 5 Phase I SBIR awards and 2 Phase II's since 1983 with three different agencies, I believe that we can offer some valid criticisms and suggestions. First of all, we are strong advocates of the SBIR program and believe that some good technology and innovative products will result from it. My comments at the Price Waterhouse briefing on Thursday, April 25, summarized the projects that we have been working on and the anticipated results that we hope to derive from them. For the record, I would like to review them together with some comments regarding agency support and cooperation.

Our first Phase I SBIR was with the U.S. Marine Corps at Quantico, Virginia and began in September, 1983 to design and test a remote-controlled, portable, electroluminescent landing zone lighting system for support of assault operations at night. This system was developed for use with and without night vision goggles and permits the pilot of the aircraft to use radio control from as far away as 10 miles to turn on and off and adjust the brightness of his landing field lights. We flight-tested the system with both the Army National Guard and the Marines at Camp Lejeune and delivered the prototype system in June, 1984. The program has experienced a high turnover of responsible personnel at Quantico and has suffered a significant delay in action on Phase II. After waiting for another technical monitor to arrive, we submitted the Phase II proposal on October 5th of 1984 and are still awaiting a decision. Because of this excessive delay, we may lose our technological edge. In addition, they can't account for all prototypes delivered and we are fearful one could be in the hands of potential competition. Initiation of funding support was also a problem for this project. Although we began the program in September 1983 and submitted the first invoice after 30 days, it was the middle of January 1984 before we received our first progress payment. This forced us to have to borrow money against our personal assets to finance the project until monies became available.

Our second SBIR later in 1983 was with the National Cancer Institute of NIH for the development of an implantible/retrievable radioisotope capsule for remote, bronchoscopic treatment of lung cancer. This program has been very successful; we implanted and retrieved five such capsules in a goat at Johns Hopkins and have already initiated a Phase II program in September of 1984. We have experienced the least number of agency-support problems with this project, but the 5% cost sharing can be a burden for new start-up businesses who have no sales to compensate for it. The monies are available in advance and payments are received promptly within two weeks of invoice.

The third SBIR was with NASA for the development of an enhanced heat transfer fluid for potential use aboard the space station. This program with NASA-Huntsville also began in late 1983 and both the final report and Phase II proposal were delivered in the Spring of 1984. NASA's method of payment (1/3 initial and 1/3 in the middle) was a great help in the beginning, but the 1/3 at the end created some problems for us. We did not receive the final payment until September 1984 and once again had to borrow against our personal assets to finance the project. It should be pointed out that the cost of borrowing money even for support of a government sponsored SBIR program is not an allowable indirect expense and comes out of the company's profit, if one really exists. We were notified on October 17, 1984 that we had been awarded a Phase II for continuation of the project, but as of this date, nothing has begun. Apparently there is only one contracting person at NASA-Huntsville and all action is funneled through him. We have signed all paperwork sent to us and apparently there is a communications problem between NASA and DCAA regarding indirect rates. These rates have been accepted by DHHS and cannot be different for other SBIR projects. An initial payment on the Phase II cannot be made, so it will be 90 days before we can receive compensation if and when we begin.

Our fourth SBIR was with the U.S. Army at Ft. Detrick for the development of a spring-powered infusion pump and suction device for use in field medical operations. This effort began in March 1984 and working prototypes and the final reports were delivered in late October. The delivered prototypes proved the conceptual feasibility of the devices and we were told that specific requirements for further efforts would have to come from the Army field medical committee which was to meet in January 1985. When we telephoned our Army technical monitor in late February, we were told that because there was no field requirement for the devices, there could be no Phase II effort. At no time had we been told that there was no requirement for the items we had been working on; in fact, we had been encouraged to proceed and incurred a cost overrun on the project. We later learned that the Army had apparently issued three Phase I awards for the same topic for which they had no requirement. In our opinion, this is an abuse of the SBIR program and we have so informed the Army. Indeed, we believe the military is trying to get Phase II results from Phase I monies. In addition, they still have yet to complete payment to us for the program that ended in October 1984.

Our fifth SBIR was with the National Institute of Aging with NIH for the development of a restraint device to prevent dangerous falls among the elderly in nursing homes. This effort began in the fall of 1984 and ended in March of 1985. Our results have been good and we anticipate applying for a Phase II in August 1985. Once again, the support and cooperation has been superb with NIH; the checks arrive on and in time.

As you can observe, our experience with the SBIR program have been varied DOD deserves the most criticism for lack of both internal and external communications, failure to pay on time - if at all, and actions bordering on deceit. On a scale of 1 to 10, we would give them a 1 or 2. NASA was better, but their Phase II inaction and slowness of payment following Phase I would earn them a 5 or 6. NIH deserves the most praise, in our opinion. Their position and support has been unwavering and the easiest to live with. We give them a 9. After all the glowing praise we heard last week (particularly for DOD), we feel that it may be more useful to hear from another of "Milt's Aces" that calls them as we see them.

In closing, let me say that the SBIR program is good and definitely should be supported. Much good will undoubtedly come from it, but we believe that it could be improved by requiring the agencies to have a real need for the topics they list. It is unfair to encourage small businesses to work on projects for which they have little or no intention to continue to Phase II. It would be extremely helpful if agencies would adopt a policy similar to NIH regarding advance payments, which it extends even on contracts. Small businesses don't need to carry the federal government on their back for 90 or more days; cash flow is the critical issue for most start-up companies. Also, we believe that a good case can be made for a flat indirect rate, particularly in Phase I. It does not seem fair for small businesses doing relatively small levels of government contracting to be subject to the same accounting and auditing procedures as large prime contractors. It cost us an additional $10,000 last year to use the services of a CPA who is familiar enough with government contracts to structure our accounting system in a manner satisfactory to DCAA. The latter group has been no help to us whatsoever; two audits in 6 months and significant foot-dragging, with regard to the NASA Phase II program, has been an obstacle. We would like to send them to General Dynamics.

Thank you for this opportunity to include our experience and opinions in the subcommittee records.

Yours very truly,

David P. Colvin

David P. Colvin, Ph.D.
President

Virginia S. Colvin

Virginia S. Colvin
Vice President

cc: Congressman Cobey